SOIL SURVEY OF

Livingston County, Michigan

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Michigan Agricultural Experiment Station

Issued November 1974

Major fieldwork for this soil survey was completed in 1966. Soil names and descriptions were approved in 1968. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1967. This survey was made cooperatively by the Soil Conservation Service and the Michigan Agricultural Experiment Station. It is part of the technical assistance furnished to the South Livingston Soil Conservation District, the Northwest Livingston Soil Conservation District, and the Fenton Soil Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Livingston County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the woodland group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units and the woodland groups.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and recreation areas in the sections "Use of Soils for Town and Country Planning" and "Recreation."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Livingston County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "General Nature of the County."

Cover: An area of the Miami-Conover soil association. This association, the most extensive in the county, makes up about 33 percent of the total acreage.

U S. GOVERNMENT PRINTING OFFICE: 1974

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

Contents

Issued November 1974

SOIL SURVEY OF LIVINGSTON COUNTY, MICHIGAN

BY CLARENCE A. ENGBERG AND FRANKLIN R. AUSTIN

FIELDWORK BY CLARENCE ENGBERG, GILBERT LANDTISER, ISAAC GREGORY, STEPHEN SHETRON, GEORGE THRELKELD, GLENN BEDELL, ALAN IRVINE, AND ROBERT BRYAN, SOIL CONSERVATION SERVICE, AND GARY STEINHARDT AND GARY BENJAMIN, MICHIGAN AGRICULTURAL EXPERIMENT STATION

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH MICHIGAN AGRICULTURAL EXPERIMENT STATION

LIVINGSTON COUNTY is in the southeastern part of Michigan (fig. 1). The county is bounded on the north by Genesee and Shiawassee Counties, on the west by Ingham County, on the south by Washtenaw County, and on the east by Oakland County. The city of Howell is the county seat and the main commercial center. The total area of Livingston County is 365,440 acres, or about 571 square miles. In 1970, 58,967 people lived in the county, according to U.S. Census data.

Figure 1.—Location of Livingston County in Michigan.

The climate is favorable for the growth of most crops common to the region, and farming is one of the principal industries. Corn, wheat, oats, and hay are the main crops. Dairy farming is the major farm enterprise. Livingston County is near the Detroit metropolitan area, and the eastern part of the county is an area of expanding urban and recreational use. Small industries are located throughout the county.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Livingston County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied and compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Miami and Boyer, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Hillsdale sandy loam, 2 to 6 percent slopes, is one of several phases within the Hillsdale series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One such mapping unit, shown on the soil map of Livingston County, is the soil complex. A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Fox-Boyer complex, 2 to 6 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Alluvial land is a land type in Livingston County.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants and as material, foundations, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a particular kind of soil and they relate this to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Livingston County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soil. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in Livingston County are discussed in the following pages. The terms for texture used in the titles for the soil associations apply to the texture of the surface layer. For example, in the title of association 1, the words moderately coarse textured and coarse textured soils refer to the texture of the surface layer.

1. Fox-Boyer-Oshtemo association

Steep or hilly, well-drained, moderately coarse textured and coarse textured soils on moraines

This association consists mainly of steep or hilly areas on moraines. Small areas of less sloping soils are on hilltops and ridgetops.

This association makes up about 18 percent of the county. About 33 percent of the association is made up of Fox soils, about 36 percent of Boyer-Oshtemo loamy sands, about 11 percent of Boyer soils, and about 20 percent of minor soils.

The well-drained Fox soils are on uplands and have a dark-brown sandy clay loam surface layer. The subsoil is dark-brown or reddish-brown sandy clay loam and gravelly loam and is underlain by gravelly sand.

The well-drained Boyer soils are on uplands and have a dark-brown loamy sand surface layer. The subsoil is brown gravelly sandy loam and gravelly light sandy clay loam and is underlain by gravelly sand.

The well-drained Oshtemo soils are on uplands and have a dark grayish-brown loamy sand surface layer.

The subsoil is yellowish-brown and brown loamy sand, sandy loam, or sandy clay loam and is underlain by gravelly sand. Oshtemo soils are deeper to effervescent limy material than Boyer soils.

The minor soils in this association are in the Hillsdale, Miami, Spinks, Carlisle, and Houghton series. The well-drained Hillsdale, Miami, and Spinks soils are on uplands. The very poorly drained Carlisle and Houghton soils occupy deep depressions, lake borders, and stream valleys.

Because slopes are steep, the major soils in this association generally are not suited to crops. They are medium or low in fertility and have a low or moderate available water capacity. The main concern of management is control of erosion.

Nearly all of this association is used for pasture, as woodland, for recreation, or is idle. Large and small lakes enhance the association for recreation.

Most of the soils in this association are underlain by gravelly sand and are a potential source for sand and gravel.

2. *Fox-Boyer-Oshtemo-Houghton association*

Nearly level to steep, well-drained, moderately coarse textured and coarse textured soils and very poorly drained organic soils on outwash plains

This association consists of mostly nearly level to strongly sloping soils on outwash plains. Small areas of steep soils are around the edges of deep depressions and along stream valleys. The very poorly drained Houghton soil is in depressions and along some of the streams.

This association makes up about 14 percent of the county. About 60 percent of the association is made up of Fox-Boyer complexes, about 20 percent of Boyer-Oshtemo loamy sands, about 10 percent of Houghton muck, and about 10 percent of minor soils.

The well-drained Fox soils have a dark-brown sandy loam surface layer. The subsoil is dark-brown or reddish-brown sandy clay loam and gravelly loam underlain by gravelly sand.

The well-drained Boyer soils have a dark-brown loamy sand surface layer. The subsoil is brown gravelly sandy loam and gravelly light sandy clay loam underlain by gravelly sand.

The well-drained Oshtemo soils have a dark grayish-brown loamy sand surface layer. The subsoil is brown and yellowish-brown loamy sand, sandy loam, or sandy clay loam underlain by gravelly sand. Oshtemo soils are deeper to effervescent limy material than Boyer soils.

Houghton soils are very poorly drained, organic soils in depressions, around lakes, or along streams. They have a black muck surface layer underlain by dark reddish-brown muck.

The minor soils in this association are the Bronson, Brady, Wasepi, and Spinks. The well-drained Spinks soils are on uplands. The moderately well drained Bronson soils and the somewhat poorly drained Brady and Wasepi soils are on lowlands and, in many places, adjacent to the very poorly drained Houghton soils.

The major soils of this association are medium or low in fertility. Houghton soils have very high available water capacity, but the Fox, Boyer, and Oshtemo soils have low or moderate available water capacity.

The main concerns of management are controlling erosion, maintaining fertility, and, on Houghton soils, improving drainage.

The more nearly level areas of this association are used as cropland. The steeper areas are in pasture or woodland or are idle. The more nearly level areas are well suited or moderately well suited to most of the cultivated crops commonly grown in the county.

Most of the soils of this association are underlain by gravelly sand and are a potential source for sand and gravel.

3. *Spinks-Oakville-Boyer-Oshtemo association*

Strongly sloping to hilly, well-drained, coarse-textured soils dominantly on moraines

This association consists of mostly strongly sloping to hilly uplands on moraines (fig. 2).

This association makes up about 6 percent of the county. About 50 percent of the association is made up of Spinks-Oakville loamy sands, about 40 percent of Boyer-Oshtemo loamy sands, and about 10 percent of minor soils.

Spinks soils are well drained and have a dark-brown loamy sand surface layer. The subsoil is very pale brown sand and brown heavy loamy sand in alternating layers, and it is underlain by light yellowish-brown sand.

Oakville soils are well drained and have a dark grayish-brown fine sand surface layer. The subsoil is yellowish-brown fine sand underlain by very pale brown or yellowish-brown fine sand.

The well-drained Boyer soils are on uplands and have a dark-brown loamy sand surface layer. The subsoil is brown gravelly sandy loam and gravelly light sandy clay loam underlain by gravelly sand.

The well-drained Oshtemo soils are on uplands and have a dark grayish-brown loamy sand surface layer. The subsoil is yellowish-brown and brown loamy sand, sandy loam, or sandy clay loam underlain by gravelly sand. Oshtemo soils are deeper to effervescent limy material than Boyer soils.

The minor soils in this association are the Fox, Brady, Rifle, and Tawas. The well-drained Fox soils are on uplands. The somewhat poorly drained Brady soils are on lowlands and in areas around lakes or areas adjacent to muck soils. The very poorly drained Rifle and Tawas soils are in depressions or around lakes and along streams.

The major soils in this association are low in fertility and have a low available water capacity. The main concerns of management are droughtiness, maintenance of fertility, and erosion control.

Most areas of these soils are idle or are used for woodland or recreation. The soils are poorly suited to the crops commonly grown in the area and are only moderately well suited to pasture and as woodland.

4. *Carlisle-Houghton-Gilford association*

Nearly level, very poorly drained, organic soils and moderately coarse textured soils on outwash plains, in glacial drainageways, and on lake plains

This association consists of nearly level soils on broad to narrow outwash plains, in glacial drainageways, and in small areas on lake plains.

Figure 2.—**Spinks-Oakville-Boyer-Oshtemo association in hilly areas. The well-drained Boyer-Oshtemo loamy sands occur in strongly sloping areas in the background, and the somewhat poorly drained Brady loamy sand is in the nearly level area in the foreground.**

This association makes up about 19 percent of the county. About 45 percent of the association is made up of Carlisle soils, about 10 percent of Houghton soils, about 10 percent of Gilford soils, and about 35 percent of minor soils.

Carlisle soils are very poorly drained, low-lying soils. They have a black muck surface layer underlain by brown muck material. Houghton soils also are very poorly drained, low-lying soils. They have a black muck surface layer underlain by dark reddish-brown muck. Gilford soils are very poorly drained mineral soils that have a very dark gray sandy loam surface layer. The subsoil is dark grayish-brown, grayish-brown, and light brownish-gray sandy loam and sandy clay loam that has brownish-yellow mottles. It is underlain by gray gravelly sand.

The minor soils in this association are the Colwood, Wasepi, Brady, and Bronson. Colwood soils are poorly drained and are on lake plains. Small areas of the somewhat poorly drained Wasepi and Brady soils and the moderately well drained Bronson soils occur on the borders of the poorly drained lowlands.

The major soils in this association are moderately well suited to crops if they are adequately drained. Carlisle and Houghton soils have very high available water capacity and low fertility. Gilford soils have low available water capacity and medium fertility. The main concerns of management are control of soil blowing, water management, and maintaining fertility.

Land use is variable in this association. In general, most areas are idle or used as woodland. Some areas are used as cropland and pasture. If adequately drained, the soils are moderately well suited to most crops commonly grown in the area, particularly to corn and vegetable crops.

5. *Miami-Hillsdale association*

Strongly sloping to hilly, well-drained, medium-textured and moderately coarse textured soils on moraines and till plains

This association consists of mostly strongly sloping to hilly soils on moraines and till plains.

This association makes up about 6 percent of the county. About 50 percent of the association is made up of Miami soils, about 30 percent of Hillsdale soils, and about 20 percent of minor soils.

Miami soils are well-drained soils on uplands and have a dark grayish-brown loam surface layer. The subsoil is yellowish-brown and brown clay loam underlain by brown loam. Hillsdale soils are well-drained soils on uplands and have a very dark grayish-brown sandy loam surface layer. The subsoil is brown and yellowish-brown sandy clay loam and sandy loam underlain by brown sandy loam.

The minor soils in the association are the Conover, Brookston, Spinks, Fox, Boyer, and Carlisle. The somewhat poorly drained Conover and poorly drained Brookston soils are in depressions and along drainageways. The well-drained Spinks, Fox, and Boyer soils occur on more sandy uplands. The very poorly drained Carlisle soils are in depressions and along some drainageways.

Because of slope, most areas of the major soils in this association are only moderately well suited to poorly suited as cropland. The soils are medium or high in fertility and moderate or high in available water capacity. The main concern of management is erosion control.

The less sloping areas are used for crops commonly grown in the county. The more hilly areas are used for pasture, as woodland, and for recreation.

6. *Miami-Conover association*

Nearly level to strongly sloping, well-drained and somewhat poorly drained, medium-textured soils on till plains and moraines

This association consists of mostly nearly level to strongly sloping soils on till plains and low moraines.

This association makes up about 33 percent of the county. About 35 percent of the association is made up of Miami soils, about 15 percent of Conover soils, and about 50 percent of minor soils.

Miami soils are well-drained soils on uplands and have a dark grayish-brown loam surface layer. The subsoil is yellowish-brown and brown clay loam underlain by brown loam. Conover soils are somewhat poorly drained, lower lying soils on uplands. They have a very dark grayish-brown loam surface layer. Their subsoil is mottled yellowish-brown, grayish-brown, dark-brown, and pale-brown clay loam that is underlain by mottled yellowish-brown, brown, grayish-brown, and light brownish-gray light clay loam to loam.

The minor soils in the association are the Owosso, Metea, Metamora, Brookston, and Carlisle. The well-drained Owosso and Metea soils are associated with the Miami soils in the uplands. They are coarser textured in the surface layer and upper part of the subsoil than Miami soils. The somewhat poorly drained Metamora soils are associated with Conover soils. Metamora soils are coarser textured in the surface layer and upper part of the subsoil than Conover soils. The poorly drained Brookston soils are in depressions and along drainageways. The very poorly drained Carlisle soils are in low depressions and low drainageways.

The major soils in this association are well suited to the cultivated crops commonly grown in the county. They are high in fertility and available water capacity. The main concerns of management are maintaining tilth and fertility, controlling erosion, and improving drainage in the wetter areas.

Most areas of these soils are used as cropland or pasture. Some areas are used as woodland.

7. *Miami-Brookston association*

Nearly level to gently sloping, well-drained and poorly drained, medium-textured soils on till plains

This association consists of mostly nearly level to gently sloping soils on till plains.

This association makes up about 4 percent of the county. About 50 percent of the association is made up of Miami soils, about 25 percent of Brookston soils, and about 25 percent of minor soils.

Miami soils are well-drained soils on uplands and have a dark grayish-brown loam surface layer. The subsoil is yellowish-brown and brown clay loam underlain by brown loam. Brookston soils are poorly drained and occupy depressed areas in the uplands. They have a very dark brown loam surface layer and a dark-gray and gray clay loam subsoil that has dark yellowish-brown, yellowish-brown, and dark-brown mottles. They are underlain by dominantly mottled gray and yellowish-brown loam to light clay loam.

The minor soils are the Hillsdale, Metamora, Locke, and Linwood. The well-drained Hillsdale soils are associated with Miami soils in the higher areas. The somewhat poorly drained Metamora and Locke soils are on the lower side slopes of the higher areas. The very poorly drained Linwood soils are associated with Brookston soils and are in depressions and drainageways.

The major soils of this association are high in fertility. Available water capacity is high. The main concerns of management are maintaining tilth and fertility, controlling erosion on the uplands, and providing adequate drainage for Brookston soils.

Most areas of these soils are used as cropland or pasture, but some small areas are used for woodlots. The soils are well suited to crops commonly grown in the county if drainage is adequate in the wetter areas.

Descriptions of the Soils

This section describes the soil series and mapping units in Livingston County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the series to which it belongs.

An important part of the description of each series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping

units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are either stated in describing the mapping unit or are apparent in the name of the mapping unit. Color terms are for moist soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Alluvial land and Borrow pits, for example, do not belong to a soil series, but, nevertheless, are listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit and woodland suitability group in which the mapping unit has been placed. The page for the description of each capability unit and suitability group can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*4*).[1]

[1] Italic numbers in parentheses refer to Literature Cited, p. 90.

TABLE 1.—*Approximate acreage and proportionate extent of soils*

Soil	Acres	Percent
Alluvial land	1,498	0.4
Arkport fine sandy loam, 0 to 2 percent slopes	448	.1
Arkport fine sandy loam, 2 to 6 percent slopes	771	.2
Arkport fine sandy loam, 6 to 12 percent slopes	188	.1
Barry sandy loam	122	(1)
Berville loam	538	.1
Borrow pits	109	(1)
Boyer loamy sand, 0 to 2 percent slopes	654	.2
Boyer loamy sand, 2 to 6 percent slopes	3,966	1.0
Boyer loamy sand, 6 to 12 percent slopes	3,299	.9
Boyer loamy sand, silty substratum, 0 to 2 percent slopes	305	.1
Boyer loamy sand, silty substratum, 2 to 6 percent slopes	774	.2
Boyer-Oshtemo loamy sands, 0 to 2 percent slopes	12,221	3.3
Boyer-Oshtemo loamy sands, 2 to 6 percent slopes	12,421	3.3
Boyer-Oshtemo loamy sands, 6 to 12 percent slopes	5,998	1.6
Boyer-Oshtemo loamy sands, 12 to 18 percent slopes	7,081	1.9
Boyer-Oshtemo loamy sands, 18 to 25 percent slopes	5,177	1.4
Boyer-Oshtemo loamy sands, 25 to 35 percent slopes	1,898	.5
Brady loamy sand, 0 to 2 percent slopes	2,034	.5
Breckenridge loamy sand	639	.2
Bronson loamy sand, 0 to 2 percent slopes	4,693	1.2
Brookston loam	4,881	1.3
Carlisle muck	37,091	10.0
Colwood fine sandy loam	2,722	.7
Conover loam, 0 to 2 percent slopes	12,252	3.3
Conover loam, 2 to 6 percent slopes	2,985	.8
Conover-Miami loams, 0 to 2 percent slopes	1,933	.5
Edwards muck	2,191	.5
Fox sandy loam, 0 to 2 percent slopes	10,707	2.9
Fox sandy loam, 2 to 6 percent slopes	8,694	2.3
Fox sandy loam, 6 to 12 percent slopes	4,495	1.2
Fox-Boyer complex, 2 to 6 percent slopes	10,205	2.8
Fox-Boyer complex, 6 to 12 percent slopes	3,737	1.0
Fox-Boyer complex, 12 to 18 percent slopes	10,909	3.0
Fox-Boyer complex, 18 to 25 percent slopes	10,284	2.8
Fox-Boyer complex, 25 to 40 percent slopes	5,296	1.4
Gilford sandy loam	6,815	1.8
Gravel pits	461	.1
Hillsdale loamy sand, 2 to 6 percent slopes	503	.1
Hillsdale loamy sand, 6 to 12 percent slopes	505	.1
Hillsdale sandy loam, 2 to 6 percent slopes	5,105	1.4
Hillsdale sandy loam, 6 to 12 percent slopes	2,188	.6
Hillsdale sandy loam, 12 to 18 percent slopes	1,999	.5
Hillsdale sandy loam, 18 to 25 percent slopes	860	.2
Hillsdale-Miami loams, 2 to 6 percent slopes	3,797	1.0
Hillsdale-Miami loams, 6 to 12 percent slopes	860	.2
Houghton muck	13,582	3.6
Lake beaches	96	(1)
Lamson fine sandy loam	1,576	.4
Linwood muck	4,806	1.3
Locke sandy loam, 0 to 4 percent slopes	1,001	2.7
Made land	212	.1
Metamora sandy loam, 0 to 4 percent slopes	4,280	1.1
Metea loamy sand, 0 to 2 percent slopes	411	.1
Metea loamy sand, 2 to 6 percent slopes	1,920	.5
Metea loamy sand, 6 to 12 percent slopes	493	.1
Miami loam, 0 to 2 percent slopes	569	.2
Miami loam, 2 to 6 percent slopes	33,301	8.9
Miami loam, 6 to 12 percent slopes	12,737	3.5
Miami loam, 12 to 18 percent slopes	8,966	2.4
Miami loam, 18 to 25 percent slopes	4,001	1.1
Miami loam, 25 to 35 percent slopes	1,021	.3
Miami-Conover loams, 2 to 6 percent slopes	5,728	1.5
Minoa-Thetford complex, 0 to 4 percent slopes	3,214	.9
Oakville fine sand, 0 to 6 percent slopes	1,901	.5
Oakville fine sand, loamy substratum, 0 to 6 percent slopes	2,414	.6
Ottokee loamy sand, 0 to 2 percent slopes	481	.1
Ottokee loamy sand, 2 to 6 percent slopes	569	.1
Owosso-Miami sandy loams, 0 to 2 percent slopes	2,579	.7
Owosso-Miami sandy loams, 2 to 6 percent slopes	9,031	2.4
Owosso-Miami sandy loams, 6 to 12 percent slopes	2,689	.7
Owosso-Miami sandy loams, 12 to 18 percent slopes	849	.2
Pewamo clay loam	1,796	.4
Rifle muck	2,451	.7
Sebewa loam	2,014	.5
Spinks-Oakville loamy sands, 0 to 6 percent slopes	7,079	1.9
Spinks-Oakville loamy sands, 6 to 12 percent slopes	3,215	.9
Spinks-Oakville loamy sands, 12 to 18 percent slopes	2,293	.6
Spinks-Oakville loamy sands, 18 to 25 percent slopes	1,866	.5
Spinks-Oakville loamy sands, 25 to 35 percent slopes	737	.2
Tawas muck	3,652	1.0
Warners loam	589	.2
Wasepi sandy loam, 0 to 2 percent slopes	2,773	.8
Washtenaw silt loam	2,239	.6
Total	365,440	100.0

[1] Less than 0.05 percent.

Alluvial Land

Alluvial land (Ad) is scattered throughout the county on flood plains next to streams. It formed from materials deposited by streams when they were in flood stage.

The soils in this mapping unit range from loamy sand to loam or clay loam and are well drained to poorly drained. The natural drainage is dominantly somewhat poorly or poorly drained. The soils are so variable, so intricately intermingled, and in such small areas that it is not practical to map them separately. Alluvial land is low lying and occurs in narrow bands adjacent to streams. In places the bands are only 50 feet wide. In many places the soil material varies within short distances. More of this mapping unit is loam than sand.

Included with this land in mapping are a few areas that have thin bands of organic material separated by mineral material. In these included areas, the mineral bands of soil are thicker than the organic bands.

Alluvial land is severely limited for cultivation because it is subject to flooding and occurs in small, narrow strips. Some areas are suitable for recreational uses. Capability unit Vw–1 (L–2c); not in a woodland suitability group.

Arkport Series

The Arkport series consists of nearly level to strongly sloping, well-drained soils on lake plains. These soils formed in deep, stratified fine sandy loam, loam, and silt.

In a representative profile the surface layer is dark grayish-brown fine sandy loam 10 inches thick. The subsurface layer is brown loamy fine sand 6 inches thick. The subsoil is 26 inches thick. It consists of layers, 2 to 8 inches thick, of dark-brown or yellowish-brown, mostly friable fine sandy loam, silt, silt loam, and light silty clay loam. The underlying material, to a depth of 60 inches, consists of layers of dark-brown or yellowish-brown fine sandy loam, silt, and loam that range in thickness from 4 to 12 inches.

Permeability is moderate. The available water capacity is moderate, and fertility is medium. Surface runoff is slow.

Arkport soils are moderately well suited to farming and as woodland. They have few limitations for nonfarm uses.

Representative profile of Arkport fine sandy loam, 2 to 6 percent slopes, in a cultivated field in NW¼SW¼ sec. 12, T. 4 N., R. 4 E.:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—10 to 16 inches, brown (10YR 5/3) loamy fine sand; single grain; loose; slightly acid; abrupt, irregular boundary.

B21—16 to 20 inches, yellowish-brown (10YR 5/6) fine sandy loam; weak, fine, subangular blocky structure; friable; neutral; clear, wavy boundary.

IIB22—20 to 22 inches, dark-brown (10YR 4/3) light silty clay loam; moderate, medium, subangular blocky structure; friable; neutral; abrupt, wavy boundary.

IIIB23—22 to 30 inches, dark-brown (10YR 4/3) silt; weak, medium, subangular blocky structure; friable; neutral; abrupt, wavy boundary.

IIIB24—30 to 38 inches, yellowish-brown (10YR 5/6) fine sandy loam; weak, medium, subangular blocky structure; friable; neutral; abrupt, wavy boundary.

IIIB25—38 to 42 inches, dark-brown (10YR 4/3) silt loam; weak, medium, subangular blocky structure; friable; neutral; abrupt, wavy boundary.

IIIC1—42 to 48 inches, dark-brown (10YR 4/3) loam; massive; friable; mildly alkaline, slightly effervescent; abrupt, wavy boundary.

IIIC2—48 to 54 inches, yellowish-brown (10YR 5/4) fine sandy loam; massive; friable; mildly alkaline, slightly effervescent; abrupt, wavy boundary.

IIIC3—54 to 60 inches, dark-brown (10YR 4/3) silt; massive; friable; mildly alkaline, slightly effervescent.

The Ap horizon is dark grayish-brown (10YR 4/2) or very dark grayish-brown (10YR 3/2). The C horizon is dominantly stratified silt, fine sand, and very fine sand, but it contains strata of loam, fine sandy loam, clay, or clay loam. It is dark brown (10YR 4/3), yellowish brown (10YR 5/4), dark grayish brown (10YR 4/2), or dark yellowish brown (10YR 4/4). The C horizon is mildly or moderately alkaline and slightly or strongly effervescent.

In Livingston County the B and C horizons of these soils have a texture finer than that defined as the range for the series, but this difference seems not to alter the usefulness and behavior of the soils.

Arkport soils commonly are adjacent to Lamson and Minoa soils. They lack mottles that are in the B horizon of Lamson and Minoa soils. They are similar to Spinks soils but are finer textured than those soils.

Arkport fine sandy loam, 0 to 2 percent slopes (ApA).—This soil is in small tracts on lake plains.

Included with this soil in mapping are a few small areas of somewhat poorly drained Minoa and Thetford soils and poorly drained Lamson soils. The Arkport soils are better drained than these inclusions.

Surface runoff is slow, permeability is moderate, and the erosion hazard is slight.

This soil is moderately well suited to farming and as woodland. The principal concern of management on this soil is moisture conservation. Capability unit IIIs–3 (3a); woodland suitability group 3s5.

Arkport fine sandy loam, 2 to 6 percent slopes (ApB).—This soil is on undulating lake plains. It has the profile described as representative for the series.

Included with this soil in mapping are small areas that have a surface layer of sandy loam or loamy fine sand. A few areas that have a finer textured profile than that described as representative for the series are also included. In these areas, layers of light clay loam and more layers of silt occur in the profile. In waterways and small depressions are small areas of wetter Lamson and Minoa soils.

Surface runoff is slow, permeability is moderate, and the erosion hazard is slight. The principal concern of management is moisture conservation.

This soil is moderately well suited to farming and as woodland. Capability unit IIIs–4 (3a); woodland suitability group 3s5.

Arkport fine sandy loam, 6 to 12 percent slopes (ApC).—This soil is in small areas on lake plains.

Included with this soil in mapping are small areas that have a loamy fine sand or sandy loam surface layer. In addition, small areas of the less stratified Hillsdale soils are included in the mapping. Small areas of poorly drained Lamson and somewhat poorly drained Minoa soils, in small depressions and waterways, are also included.

Surface runoff is slow, permeability is moderate, and the erosion hazard is moderate. The principal concerns

of management on this soil are moisture conservation and erosion control.

This soil is moderately well suited to farming and as woodland. Capability unit IIIe-9 (3a); woodland suitability group 3s5.

Barry Series

The Barry series consists of nearly level, very poorly drained soils on till plains and moraines. These soils formed in loamy sand, loamy fine sand, sandy loam, or fine sandy loam materials.

In a representative profile the surface layer is very dark gray sandy loam 10 inches thick. The subsoil is 24 inches thick. The upper 4 inches is dark-gray sandy loam that has mottles of yellowish brown, grayish brown, and olive brown. The next 14 inches is mottled grayish-brown and yellowish-brown, friable light sandy clay loam. The lower part is mottled olive-gray, brownish-yellow, yellowish-brown, and light olive-gray, friable loam 6 inches thick. The underlying material, at a depth of 34 inches, is mottled yellowish-brown, light olive-brown, and dark-gray heavy sandy loam. At a depth of 38 inches, the underlying material is mottled light olive-brown, grayish-brown, and light brownish-gray loamy fine sand.

Permeability is moderate. The available water capacity is moderate, and the fertility is medium. Surface runoff is very slow.

If adequately drained, these soils are well suited to farming, particularly to row crops. They are poorly suited as woodland. They have severe limitations for nonfarm uses.

Representative profile of Barry sandy loam, in a cultivated area in NE¼NW¼ sec. 22, T. 4 N., R. 3 E.:

Ap—0 to 10 inches, very dark gray (10YR 3/1) sandy loam; weak, medium, granular structure; very friable; less than 5 percent coarse fragments; mildly alkaline; abrupt, smooth boundary.

B1g—10 to 14 inches, dark-gray (10YR 4/1) heavy sandy loam; common, fine, faint, grayish-brown (10YR 5/2) mottles and common, fine, distinct, yellowish-brown (10YR 5/6) and olive-brown (2.5Y 4/4) mottles; weak, medium, subangular blocky structure; friable; few worm casts and organic stains along old, very dark-gray (10YR 3/1) root channels; less than 5 percent coarse fragments; mildly alkaline; clear, wavy boundary.

B21tg—14 to 28 inches, mottled grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/6) light sandy clay loam; weak, medium, subangular blocky structure; friable; dark-gray (5Y 4/1) clay films on surface of many peds and along old root channels; less than 5 percent coarse fragments; mildly alkaline; clear, wavy boundary.

B22tg—28 to 34 inches, mottled olive-gray (5Y 5/2), brownish-yellow (10YR 6/8), yellowish-brown (10YR 5/8), and light olive-gray (5Y 6/2) loam; weak, medium, subangular blocky structure; friable; few gray (5Y 5/1) clay films on surfaces of peds and along root channels; less than 5 percent coarse fragments; mildly alkaline; abrupt, wavy boundary.

C1—34 to 38 inches, mottled yellowish-brown (10YR 5/8), light olive-brown (2.5Y 5/4), and dark-gray (N 4/0) heavy sandy loam; massive; very friable; slightly effervescent; clear, wavy boundary.

IIC2—38 to 60 inches, mottled light olive-brown (2.5Y 5/4), grayish-brown (2.5Y 5/2), and light brownish-gray (10YR 6/2) loamy fine sand; massive; very friable; 5 percent coarse fragments; mildly alkaline, slightly effervescent.

The A horizon ranges from 10 to 14 inches in thickness. The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and is 8 to 10 inches in thickness. An A11 horizon, where present, is black (10YR 2/1) or very dark brown (10YR 2/2) and is 3 to 5 inches in thickness. An A12 horizon, where present, is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3). It is 1 to 6 inches thick immediately beneath an Ap horizon and 7 to 9 inches thick immediately beneath an A11 horizon. The B21tg horizon is dark gray (5Y 4/1) and contains light olive-brown (2.5Y 5/4) mottles. The B22tg horizon ranges from heavy sandy loam to light clay loam. The C horizon is loamy sand, loamy fine sand, sandy loam, or fine sandy loam. It is mildly or moderately alkaline and slightly or strongly effervescent.

Barry soils are adjacent to the well-drained Hillsdale soils and the somewhat poorly drained Locke soils. They formed under drainage conditions similar to those of the Brookston, Breckenridge, Sebewa, and Washtenaw soils. Barry soils are more poorly drained than Hillsdale and Locke soils. They are coarser textured in the lower part of the C horizon than Brookston and Breckenridge soils. Barry soils have a finer textured C horizon than Sebewa soils and a thinner solum than Washtenaw soils.

Barry sandy loam (0 to 2 percent slopes) (Ba).—This soil is in small, irregular areas in depressions and drainageways of moraines and till plains.

Included with this soil in mapping are small, slightly higher areas of somewhat poorly drained Locke soils, which are not so wet as Barry soils. Also included are small areas of cobblestones.

Surface runoff is very slow, permeability is moderate, and the erosion hazard is slight. The principal concern of management on this soil is maintaining adequate drainage.

If adequately drained, this soil is well suited to farming, particularly to row crops. It is poorly suited as woodland. Capability unit IIw-6 (3c); woodland suitability group 4w3.

Berville Series

The Berville series consists of very poorly drained, nearly level soils on till plains and lake plains. These soils formed in sandy loam materials underlain by heavy loam.

In a representative profile the surface layer is black loam 10 inches thick. The subsoil is 22 inches thick. It is mainly gray, friable light sandy clay loam that has yellowish-brown, strong-brown, light olive-brown, and olive-brown mottles. The underlying material, to a depth of 60 inches, is dark-gray heavy loam that contains olive-brown, light olive-brown, and olive mottles.

Permeability is moderately slow. The available water capacity and fertility are high. Surface runoff is very slow.

If adequately drained, these soils are well suited to farming. They are poorly suited as woodland. The Berville soils have severe limitations for most nonfarm uses.

Representative profile of Berville loam, in an idle field in NW¼NE¼ sec. 15, T. 3 N., R. 3 E.:

Ap—0 to 10 inches, black (10YR 2/1) loam; moderate, medium, granular structure; friable; less than 10 percent coarse fragments; mildly alkaline; abrupt, smooth boundary.

B21tg—10 to 12 inches, dark-gray (5YR 4/1) light sandy clay loam; common, fine, distinct, brown (7.5YR 4/4) and

yellowish-brown (10YR 5/6) mottles and common, fine, faint, dark grayish-brown (10YR 4/2) mottles; weak, fine, subangular blocky structure; friable; very dark brown (10YR 2/2) films on surface of a few peds, along cracks, and in old root channels; less than 10 percent coarse fragments; mildly alkaline; abrupt, smooth boundary.

B22tg—12 to 32 inches, gray (5Y 5/1) light sandy clay loam; common, fine, distinct, yellowish-brown (10YR 5/6), strong-brown (7.5YR 5/6), light olive-brown (2.5Y 5/4), and olive-brown (2.5Y 4/4) mottles; weak, coarse, subangular blocky structure; friable; thin clay films on surfaces of many peds and along root channels; 15 percent coarse fragments; mildly alkaline; abrupt, wavy boundary.

IICg—32 to 60 inches, dark-gray (5Y 4/1) heavy loam; common, fine, distinct, olive-brown (2.5Y 4/4), light olive-brown (2.5Y 5/4), and olive (5Y 4/3) mottles; massive; firm; 10 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum generally is 30 to 45 inches but ranges from 20 to 50 inches. The Ap horizon ranges from 6 to 12 inches in thickness. If the Ap horizon is less than 10 inches thick, there is a very dark gray (10YR 3/1) A12 horizon ranging from 1 to 4 inches in thickness. The A horizon is 10 to 14 inches thick. In a few profiles the Ap horizon contains up to 10 percent organic matter. The B21tg horizon is sandy clay loam or loam and is 2 to 8 inches thick. Films on the surface of peds, along cracks, and in old root channels in the B21tg horizon are very dark grayish brown (10YR 3/2) or very dark brown (10YR 2/2). The thickness of the B22tg horizon generally is 10 to 25 inches but ranges from 8 to 30 inches. This horizon is sandy clay loam or loam. The B22tg horizon ranges from gray (5Y 5/1) and dark gray (5Y 4/1) to gray (10YR 5/1) and dark gray (10YR 4/1). In a few soil profiles a B23tg horizon is present. It ranges from sandy loam to sandy clay loam or gravelly counterparts of these textures and contains 10 to 30 percent gravel. In a few profiles a layer of very gravelly sand, 4 to 15 inches thick, is between the Btg and IICg horizons. In a few soil profiles a clay loam or loam IIBtg horizon, 4 to 8 inches thick, is present. The IIC horizon is mildly or moderately alkaline and slightly or strongly effervescent.

Berville soils formed under conditions similar to Sebewa, Barry, and Brookston soils. Berville soils lack the gravelly sand that is in the C horizon of Sebewa soils. Berville soils have a finer textured C horizon than Barry soils and a coarser textured B horizon than Brookston soils.

Berville loam (0 to 3 percent slopes) (Be).—This soil is in depressions and drainageways on till plains and lake plains.

Included with this soil in mapping are small areas of poorly drained Brookston and very poorly drained Gilford soils. Brookston soils lack the sandy material in the upper part of their profile, and Gilford soils are coarser textured than this Berville soil.

Surface runoff is very slow, permeability is moderately slow, and the erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

If adequately drained, this soil is well suited to farming, particularly to row crops. It is poorly suited as woodland. Capability unit IIw-8 (3/2c); woodland suitability group 4w3.

Borrow Pits

Borrow pits (Bp) are areas where the original soil profiles have been destroyed by the removal of soil material to variable depths. Borrow material includes nearly all kinds of soil material except gravel. Gravel pits are shown separately on the soil map and are described elsewhere in this section. Borrow pits are variable in size, ranging from a few acres to 20 or more acres. The excavated material has been used as fill for roads and building sites. Included are small areas of poorly drained mineral soils where the surface layer has been removed and used as topsoil for landscaping. Capability unit VIIIs-1; not assigned a woodland suitability group.

Boyer Series

The Boyer series consists of nearly level to very steep, well-drained soils on moraines, glacial drainageways, outwash plains, and valley trains. These soils formed in loamy sand. In Livingston County, Boyer soils are mapped alone and in complexes with Fox and Oshtemo soils.

In a representative profile the surface layer is dark-brown loamy sand 9 inches thick. The subsurface layer is brown loamy sand 7 inches thick. The upper part of the subsoil is brown, friable gravelly sandy loam 12 inches thick. The lower part is brown, friable gravelly light sandy clay loam 8 inches thick. The underlying material, at a depth of 36 inches, is pale-brown gravelly sand.

Permeability is moderately rapid. The available water capacity is low to moderate, and the fertility is low. Surface runoff is slow to rapid.

The nearly level to strongly sloping Boyer soils are moderately well suited to farming and as woodland. They have slight limitations for most nonfarm uses and are a good source of sand and gravel.

Representative profile of Boyer loamy sand, 2 to 6 percent slopes, in a cultivated field in SE¼SW¼ sec. 4, T. 4 N., R. 4 E.:

Ap—0 to 9 inches, dark-brown (10YR 3/3) loamy sand, light brownish gray (10YR 6/2) dry; weak, fine, granular structure; very friable; less than 10 percent coarse fragments; medium acid; abrupt, smooth boundary.

A2—9 to 16 inches, brown (7.5YR 5/4) loamy sand; weak, fine, subangular blocky structure; very friable; less than 10 percent coarse fragments; strongly acid; clear, wavy boundary.

B21t—16 to 28 inches, brown (7.5YR 4/4) gravelly light sandy loam; weak, medium, subangular blocky structure; friable; clay bridges connect sand grains; 20 percent coarse fragments; strongly acid; abrupt, irregular boundary.

B22t—28 to 36 inches, brown (7.5YR 4/4) gravelly light sandy clay loam; weak, medium, subangular blocky structure; friable; strongly acid; abrupt, irregular boundary.

IIC—36 to 60 inches, pale-brown (10YR 6/3) gravelly sand; single grain; loose; 30 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum generally is 25 to 40 inches. The Ap horizon is 6 to 10 inches thick. The A horizon is 10 to 16 inches thick. The Ap, or the A1, horizon is dark brown (10YR 3/3), dark grayish brown (10YR 4/2), or very dark grayish brown (10YR 3/2). The A2 horizon ranges from sand to light sandy loam. The B22t horizon is sandy loam, gravelly sandy loam, sandy clay loam, or gravelly sandy clay loam and is less than 10 inches thick. The B horizon, in a few profiles, consists of alternating layers of sandy loam and sandy clay loam, together with 1- to 3-inch layers of loamy sand. The irregular lower boundary of the B22t horizon has tongues 7 to 24 inches in diameter extending into the IIC horizon to a depth of 36 to 50 inches. The texture of the B22t tongues ranges from gravelly sandy loam to gravelly loam. The IIC horizon is mildly or moderately alkaline and slightly or strongly effervescent.

The Boyer soils are mapped in separate complexes with Fox and Oshtemo soils. They are in a drainage sequence with Brady and Gilford soils. The Boyer soils have a coarser tex-

tured B horizon than Fox soils. They are shallower to effervescent material than Oshtemo soils. They are better drained than Brady and Gilford soils.

Boyer loamy sand, 0 to 2 percent slopes (BrA).—This soil is in areas of outwash plains.

Included with this soil in mapping are a few areas that have a sandy loam surface layer and small areas having slopes of 3 or 4 percent. Also included, where this soil adjoins swamps and depressions, are small areas of moderately well drained Bronson soils. Other inclusions are small areas of finer textured Fox soils and deeper Oshtemo soils. Small cobbly areas are included as well.

Surface runoff is slow, permeability is moderately rapid, and the erosion hazard is slight. The principal concern of management is moisture conservation.

A large proportion of this soil is now idle or in pasture and woodland. Some, however, is in cropland. The soil is moderately well suited to the crops commonly grown in the county and is moderately well suited as woodland. Capability unit IIIs–3 (4a); woodland suitability group 3s5.

Boyer loamy sand, 2 to 6 percent slopes (BrB).—This soil is in areas on outwash plains, in wide natural drainage channels, and on hilltops within moraines. It has the profile described as representative for the series.

Included in mapping are a few areas that have a sandy loam surface layer and some small areas having slopes of less than 2 percent. Also included are small areas of finer textured Fox soils and of Oshtemo soils, which are deeper over sand. Small cobbly areas are included as well.

Surface runoff is slow, permeability is moderately rapid, and the erosion hazard is slight. The principal concern of management is moisture conservation.

A large proportion of this soil is now idle, in pasture, or in woodland, but some is used for crops. This soil is moderately well suited to the crops commonly grown in the county and is moderately well suited as woodland. Capability unit IIIs–4 (4a); woodland suitability group 3s5.

Boyer loamy sand, 6 to 12 percent slopes (BrC).—This soil is on rolling outwash plains and moraines. On outwash plains it generally occurs on the slopes adjacent to depressional areas, marshes, or streams.

Included with this soil in mapping are small areas that have a yellowish-brown surface layer. Also included are small areas of finer textured Fox soils and deeper Oshtemo soils. In addition, small cobbly areas are included.

Surface runoff is medium, permeability is moderately rapid, and the erosion hazard is moderate. The principal concerns of management are erosion control and moisture conservation.

Most areas of this soil are now in pasture or woodland, but some areas are used for crops. This soil is moderately well suited as cropland and woodland. Capability unit IIIe–9 (4a); woodland suitability group 3s5.

Boyer loamy sand, silty substratum, 0 to 2 percent slopes (BsA).—This soil is in glacial drainageways. The upper part of the profile is similar to that described as representative for the Boyer series, but at a depth of 40 to 50 inches the underlying material is silt and very fine sand.

Included with this soil in mapping are small areas that have silty material at a depth of 28 to 40 inches. Also included are small areas that have some gray mottles in the lower part of the subsoil or in the upper part of the underlying material.

Surface runoff is slow, permeability is moderately rapid, and the erosion hazard is slight. The principal concern of management is moisture conservation.

Most areas of this soil have been cleared and farmed. The soil is moderately well suited to the crops commonly grown in the county. It is moderately well suited as woodland. Capability unit IIIs–3 (4a); woodland suitability group 3s5.

Boyer loamy sand, silty substratum, 2 to 6 percent slopes (BsB).—This soil is in glacial drainageways. Its profile is similar to that described as representative for the Boyer series, except that the underlying material at a depth of 40 to 50 inches is fine sand and silt.

Included with this soil in mapping are small areas where the lower part of the subsoil or the upper part of the underlying material has gray mottles. Also included are small areas that have slopes of 6 to 12 percent.

Surface runoff is slow, permeability is moderately rapid, and the erosion hazard is slight. The principal concern of management is moisture conservation.

Most areas of this soil have been cleared and are used for crops. The soil is moderately well suited to the crops commonly grown in the county. It is moderately well suited as woodland. Capability unit IIIs–4 (4a); woodland suitability group 3s5.

Boyer-Oshtemo loamy sands, 0 to 2 percent slopes (BtA).—These soils are on moraines and outwash plains. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. Each soil makes up about 35 to 55 percent of the complex. In the morainic areas the Boyer soil is dominant, and on the outwash plains the Oshtemo soil is dominant.

Included with these soils in mapping are small, slightly lower areas of somewhat poorly drained Brady soils. Also included are small areas of finer textured Fox and Miami soils. Occasional small depressions in which there are very poorly drained Gilford soils are included. Small areas that have steeper slopes, a few of which exceed 18 percent, are included as well.

Surface runoff is slow, permeability is moderately rapid, and the erosion hazard is slight. The principal concern of management is moisture conservation.

Most areas of these soils have been cleared and cultivated in the past. Much of the acreage is now idle or in pasture. These soils are moderately well suited to crops commonly grown in the county. They are moderately well suited as woodland. Capability unit IIIs–3 (4a); woodland suitability group 3s5.

Boyer-Oshtemo loamy sands, 2 to 6 percent slopes (BtB).—These soils are on outwash plains and moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately.

Each soil makes up about 35 to 55 percent of the complex. In the southeastern part of the county, the Oshtemo soil is dominant on the outwash plains. In the rest of the county, the two soils are in about equal proportions within the complex.

In a few areas the surface layer is dark yellowish brown. Small areas of coarser textured Spinks-Oakville loamy sands are included with these soils in mapping.

Also included are small areas of finer textured Fox and Miami soils. Occasional small depressions in which there are very poorly drained Gilford and Tawas soils are included. Small areas that have steeper slopes, a few of which exceed 18 percent, are included as well.

Surface runoff is slow, permeability is moderately rapid, and the erosion hazard is slight. The principal concern of management is moisture conservation.

Most areas of these soils have been cleared and farmed. Some are now idle, in pasture, or in woodland. These soils are moderately well suited to the crops commonly grown in the area. They are moderately well suited as woodland. Capability units IIs-4 (4a); woodland suitability group 3s5.

Boyer-Oshtemo loamy sands, 6 to 12 percent slopes (BtC).—These soils are on outwash plains and moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. Each soil makes up about 35 to 55 percent of the complex. In the southeastern part of the county, the Boyer soil is dominant on the moraines and the Oshtemo soil is dominant on the outwash plains. In the rest of the county, the two soils are in about equal proportions within the complex.

Included with these soils in mapping are small areas that have a dark yellowish-brown sandy clay loam or sandy loam surface layer. Occasional small depressions in which there are very poorly drained Gilford and Tawas soils are included. Also included are small areas of the coarser textured Spinks-Oakville loamy sands.

Surface runoff is medium, permeability is moderately rapid, and the erosion hazard is moderate. The principal concerns of management are erosion control and moisture conservation.

Most areas of these soils have been cleared and farmed in the past. Many areas are now idle, in pasture, or in woodland. The soils are moderately well suited as cropland and woodland. Capability unit IIIe-9 (4a); woodland suitability group 3s5.

Boyer-Oshtemo loamy sands, 12 to 18 percent slopes (BtD).—These soils are on outwash plains and moraines. They occur on moderately steep valley slopes and on the slopes of hilly outwash plains adjoining lower-lying areas such as swamps or river valleys. The two soils are in such small areas and are so intricately intermingled that it is not practical to map them separately.

Each soil makes up about 35 to 55 percent of the complex. The proportion of Boyer and Oshtemo soils is about equal in most areas except in the southeastern part of the county. In that area the Oshtemo soil is dominant on the outwash plains and the Boyer soil is dominant on the moraines.

In places the surface layer is dark yellowish-brown sandy loam or sandy clay loam. Included with these soils in mapping are small areas of less sloping soils, as well as small areas of steeper soils. Also included are small areas of coarser textured Spinks-Oakville loamy sands.

Surface runoff is rapid, permeability is moderately rapid, and the erosion hazard is severe. The principal concern of management is erosion control.

Most areas of these soils have been cleared and farmed in the past. Only a small acreage is presently cultivated. Most areas are idle or in woodland. These soils are poorly suited as cropland but are moderately well suited as woodland. Capability unit IVe-9 (4a); woodland suitability group 3s5.

Boyer-Oshtemo loamy sands, 18 to 25 percent slopes (BtE).—These soils are on moraines and outwash plains. In areas on outwash plains, the complex is adjacent to nearly level areas of Boyer and Oshtemo soils. On moraines, the complex is between nearly level areas and swamps, pits, or rivers. The two soils are in such small areas and are so intricately intermingled that it is not practical to map them separately. Each soil makes up about 35 to 55 percent of the complex. The proportion of Boyer and Oshtemo soils is about equal in most areas. In the southeastern part of the county, however, the Oshtemo soil is dominant on the outwash plains and the Boyer soil is dominant on the moraines.

Included in mapping are areas in which the surface layer is dark yellowish-brown sandy loam or sandy clay loam. Also included are small areas that have slightly steeper slopes, as well as some less sloping areas. Other inclusions are small areas of coarser textured Spinks-Oakville loamy sands and small areas of finer textured Fox soils. Occasional small depressions in which there are very poorly drained Gilford and Tawas soils also are included.

Surface runoff is rapid, permeability is moderately rapid, and the erosion hazard is severe. The principal concern of management is erosion control.

Most areas of these soils have been cleared but are now idle or used for woodland. The soils are not suited as cropland, because of the steep slopes. They are moderately well suited as woodland, but there are moderate limitations because of slope. Capability unit VIe-2 (4a); woodland suitability group 3s6.

Boyer-Oshtemo loamy sands, 25 to 35 percent slopes (BtF).—These soils are on moraines and outwash plains. In the outwash plain areas, the soils occur between the more nearly level areas and the adjoining pits, swamps, or river valleys. They are in such small areas and are so intricately intermingled that it is not practical to map them separately.

Each soil makes up about 35 to 55 percent of the complex. In most of the county they occur in about equal proportions. In the southeastern part of the county, however, the Oshtemo soil is dominant on the outwash plains and the Boyer soil is dominant on the moraines.

Some areas included with these soils in mapping have a dark yellowish-brown sandy loam or sandy clay loam surface layer. Small hilltop areas that have slopes of 0 to 6 percent are also included. These generally are less than 1 acre in size. Small irregular areas of coarser textured Spinks-Oakville loamy sands are included as well.

Surface runoff is rapid, permeability is moderately rapid, and the erosion hazard is severe. The principal concern of management is erosion control.

Most areas of these soils have been cleared but are now idle or in woodland. The soils are not suited as cropland, because of the steep slopes. They are moderately well suited as woodland, but there are moderate limitations because of slope. Capability unit VIIe-2 (4a); woodland suitability group 3s6.

Brady Series

The Brady series consists of nearly level, somewhat poorly drained soils on outwash plains, lake plains, and valley trains. These soils formed in loamy sand and sand.

In a representative profile the surface layer is very dark grayish-brown loamy sand 8 inches thick. The subsurface layer is light yellowish-brown sand 9 inches thick. The upper part of the subsoil is yellowish-brown, very friable loamy sand 8 inches thick. The second part is strong-brown, firm sandy clay loam that has grayish-brown mottles and is 5 inches thick. The third part is mottled yellowish-brown and light brownish-gray, very friable sandy loam 7 inches thick. The lower part is light-gray, loose loamy sand 14 inches thick. The underlying material, at a depth of 51 inches, is gray gravelly sand.

Permeability is moderately rapid. The available water capacity is low, and the fertility is medium. Surface runoff is slow.

Brady soils are moderately well suited to farming and as woodland. They have moderate to severe limitations for nonfarm uses.

Representative profile of Brady loamy sand, 0 to 2 percent slopes, in a cultivated field in NW¼NW¼ sec. 15, T. 1 N., R. 4 E.:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, medium, granular structure; very friable; less than 10 percent coarse fragments; medium acid; abrupt, smooth boundary.

A2—8 to 17 inches, light yellowish-brown (10YR 6/4) sand; few, fine, faint, very pale brown (10YR 7/4) mottles; single grain; loose; less than 10 percent coarse fragments; medium acid; gradual, wavy boundary.

B1—17 to 25 inches, yellowish-brown (10YR 5/6) loamy sand; common, medium, faint, light yellowish-brown (10YR 6/4) and yellowish-brown (10YR 5/8) mottles; weak, fine, subangular blocky structure; very friable; less than 10 percent coarse fragments; medium acid; gradual, irregular boundary.

B21t—25 to 30 inches, strong-brown (7.5YR 5/8) sandy clay loam; common, medium, faint, reddish-yellow (7.5YR 6/6) mottles and common, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; clay bridges connect sand grains; less than 10 percent coarse fragments; medium acid; gradual, irregular boundary.

B22t—30 to 37 inches, mottled yellowish-brown (10YR 5/4) and light brownish-gray (10YR 6/2) sandy loam; weak, fine, subangular blocky structure; very friable; clay bridges connect sand grains; less than 10 percent coarse fragments; slightly acid; gradual, irregular boundary.

B23t—37 to 51 inches, light-gray (10YR 6/1) loamy sand; single grain; loose; less than 10 percent coarse fragments; slightly acid; abrupt, irregular boundary.

IIC—51 to 60 inches, gray (10YR 5/1) gravelly sand; single grain; loose; 20 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum generally is 45 to 60 inches. The B21t horizon is sandy loam, sandy clay loam, or clay loam. The sandy clay loam or clay loam B horizon generally is 5 to 8 inches thick but ranges from 2 to 10 inches in thickness. The IIC horizon is mildly or moderately alkaline and slightly or strongly effervescent.

In Livingston County, the upper part of these soils is dominantly coarser textured and the depth to low-chroma mottles is greater than has been defined as the range for the series. The differences seem not to alter the usefulness and behavior of the soils.

Brady soils are in a drainage sequence with Boyer, Oshtemo, Bronson, and Gilford soils. They are similar to Wasepi soils but have a thicker solum. Brady soils are wetter than the associated Boyer, Oshtema, and Bronson soils. They have a lighter colored Ap horizon and a brighter colored B horizon than Gilford soils.

Brady loamy sand, 0 to 2 percent slopes (BuA).—This soil is on outwash plains, valley trains, and lake plains.

Included with this soil in mapping are small areas of very poorly drained Gilford soils and moderately well drained Bronson soils. Bronson soils occur at slightly higher elevations, and Gilford soils are in the low areas. Also included are small areas of Minoa soils. Occasional small depressional pockets in which there are very poorly drained Tawas and poorly drained Lamson soils are also included.

Surface runoff is slow, permeability is moderately rapid, and the erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

If adequately drained, this soil is moderately well suited to all the crops commonly grown in the county. It is moderately well suited as woodland. Capability unit IIIw-5 (4b); woodland suitability group 3w2.

Breckenridge Series

The Breckenridge series consists of nearly level, poorly drained soils on till plains and lake plains. These soils formed in loamy sand and sand underlain by loam.

In a representative profile the surface layer is very dark gray loamy sand 8 inches thick. The subsurface layer is light brownish-gray loamy sand that has yellowish-brown mottles. It is 3 inches thick. The upper part of the subsoil is grayish-brown, friable sandy loam 17 inches thick. It is mottled with yellowish brown. The lower part of the subsoil is grayish-brown, firm heavy sandy loam that is mottled with yellowish brown. The underlying material, at a depth of 38 inches, is light brownish-gray sand that has yellowish-brown mottles. At a depth of 42 inches, the underlying material is grayish-brown loam.

Permeability is moderately rapid. The available water capacity is moderate, and fertility is medium. Surface runoff is very slow.

If drained, Breckenridge soils are well suited to farming. They are poorly suited as woodland, and they have moderate to severe limitations for nonfarm uses.

Representative profile of Breckenridge loamy sand, in a cultivated field in SW¼NE¼ sec. 4, T. 3 N., R. 3 E.:

Ap—0 to 8 inches, very dark gray (10YR 3/1) loamy sand; weak, fine, granular structure; friable; many finely divided bits of organic matter; less than 10 percent coarse fragments; neutral; abrupt, smooth boundary.

A2g—8 to 11 inches, light brownish-gray (10YR 6/2) loamy sand; few, fine, distinct, yellowish-brown (10YR 5/8) mottles; single grain; loose; less than 10 percent coarse fragments; neutral; clear, wavy boundary.

B21tg—11 to 28 inches, grayish-brown (10YR 5/2) sandy loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; friable; less than 10 percent coarse fragments; neutral; clear, wavy boundary.

B22tg—28 to 38 inches, grayish-brown (2.5Y 5/2) heavy sandy loam; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; weak, fine, subangular blocky structure; firm; less than 10 percent coarse fragments; neutral; clear, wavy boundary.

C1g—38 to 42 inches, light brownish-gray (2.5Y 6/2) sand; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; single grain; loose; mildly alkaline; abrupt, wavy boundary.

IIC2—42 to 60 inches, grayish-brown (2.5Y 5/2) loam; massive; firm; less than 10 percent coarse fragments; mildly alkaline, slightly effervescent.

The Ap horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). The B22tg horizon ranges from sandy loam to gravelly clay loam. The C1g horizon, where present, is loamy sand or sand and in some places is gravelly. In a few profiles, there is a IIB22tg horizon. The IIC horizon is mildly or moderately alkaline and slightly to strongly effervescent.

In Livingston County, these soils have an annual temperature a few degrees warmer than is defined as the range for the series. Also, the loamy sand texture of the surface layer is not within the defined range for the series. These differences seem not to alter the usefulness and behavior of the soils.

Breckenridge soils are in a drainage sequence with Metea and Metamora soils. They are similar to Brookston and Barry soils. Breckenridge soils are more poorly drained than the well-drained Metea soils and the somewhat poorly drained Metamora soils. They have a coarser textured solum than Brookston soils. Breckenridge soils have a finer textured IIC horizon than Barry soils.

Breckenridge loamy sand (0 to 2 percent slopes) (Bv).—This soil is in small, irregularly shaped areas in narrow, natural drainage courses and in low depressions adjacent to swampland on till plains and lake plains.

Included with this soil in mapping are a few small areas that have a sandy loam surface layer.

Surface runoff is slow, permeability is moderate, and the erosion hazard is slight. The main concern of management is maintaining adequate drainage.

If adequately drained, this soil is well suited to the crops commonly grown in the county. It is poorly suited as woodland. Capability unit IIw-8 (3/2c); woodland suitability group 4w3.

Bronson Series

The Bronson series consists of nearly level, moderately well drained soils on valley trains and outwash plains. These soils formed in loamy sand.

In a representative profile the surface layer is very dark grayish-brown loamy sand 11 inches thick. The upper part of the subsoil is yellowish-brown, friable loamy sand 17 inches thick. The lower part is brown, friable light sandy loam 14 inches thick. The underlying material, at a depth of 42 inches, is dark-gray gravelly sand.

Permeability is moderately rapid. The available water capacity and fertility are low. Surface runoff is slow.

The Bronson soils are moderately well suited to farming and as woodland. They have moderate limitations for nonfarm uses.

Representative profile of Bronson loamy sand, 0 to 2 percent slopes, in a cultivated field in NW¼SW¼ sec. 6, T. 2 N., R. 5 E.:

Ap—0 to 11 inches, very dark grayish-brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; weak, fine, granular structure; friable; less than 10 percent coarse fragments; medium acid; abrupt, smooth boundary.

B1—11 to 28 inches, yellowish-brown (10YR 5/6) loamy sand; weak, medium, granular structure separating to weak, fine, subangular blocky structure; friable; less than 10 percent coarse fragments; medium acid; abrupt, irregular boundary.

B2t—28 to 42 inches, brown (10YR 5/3) light sandy loam; few, medium, faint, yellowish-brown (10YR 5/4) mottles and few, fine, faint, grayish-brown (10YR 5/2) mottles; massive; friable; clay bridges connect sand grains; less than 10 percent coarse fragments; slightly acid; abrupt, irregular boundary.

IICg—42 to 60 inches, dark-gray (10YR 4/1) gravelly sand; single grain; loose; 20 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum is generally 40 to 60 inches. Depth to gray mottles ranges from 20 to 28 inches. The B2t horizon is sandy loam or sandy clay loam. In a few profiles yellowish-red (5YR 5/6) clay balls and sandy loam lenses are in the IICg horizon. The IIC horizon is mildly or moderately alkaline and slightly or strongly effervescent.

In Livingston County, the upper part of the solum of these soils is coarser textured than is within the range defined for the series, but this difference seems not to alter the usefulness and behavior of the soils.

Bronson soils are in a drainage sequence with Boyer, Oshtemo, and Brady soils. They have mottling in the lower part of the subsoil that is lacking in the associated Boyer and Oshtemo soils. They are better drained and more deeply mottled than the somewhat poorly drained Brady soils.

Bronson loamy sand, 0 to 2 percent slopes (BwA).—This soil is in small areas on outwash plains and valley trains.

Included with this soil in mapping are a few areas that have finer textured material at depths of 36 to 60 inches. Also included are small, slightly higher areas of well-drained Boyer and Oshtemo soils. Small areas of somewhat poorly drained Brady soils, very poorly drained Gilford soils, and very poorly drained Tawas soils that occur in depressions are included as well. Small areas that have steeper slopes are included.

Surface runoff is slow, permeability is moderately rapid, and the erosion hazard is slight. The principal concern of management is moisture conservation.

This soil is moderately well suited to the crops commonly grown in the county. It is moderately well suited as woodland. Capability unit IIIs-3 (4a); woodland suitability group 3s5.

Brookston Series

The Brookston series consists of nearly level, poorly drained soils on till plains and in depressions on moraines. These soils formed in loam or light clay loam till.

In a representative profile the surface layer is very dark brown loam 10 inches thick. The upper part of the subsoil is dark-gray, firm light clay loam that has dark yellowish-brown and yellowish-brown mottles and is 6 inches thick. The lower part is gray, firm clay loam that has dark-brown and yellowish-brown mottles and is 10 inches thick. The underlying material, at a depth of 26 inches, consists of mottled gray, light olive-gray, dark-gray, and yellowish-brown loam 10 inches thick. Below this is mottled gray, olive-gray, yellowish-brown, and light olive-brown clay loam 15 inches thick. At a depth of 51 inches is mottled grayish-brown, yellowish-brown, and strong-brown heavy loam.

Permeability is moderately slow. The available water capacity and fertility are high. Surface runoff is very slow.

If adequately drained, Brookston soils are well suited to farming, particularly to row crops. They are moderately well suited as woodland. They have severe limitations for many nonfarm uses.

Representative profile of Brookston loam, in a cultivated field in NE¼NE¼ sec. 3, T. 4 N., R. 4 W.:

Ap—0 to 10 inches, very dark brown (10YR 2/2) loam; weak, medium, granular structure; very friable; less than 5 percent coarse fragments; mildly alkaline; abrupt, smooth boundary.

B21tg—10 to 16 inches, dark-gray (5Y 4/1) light clay loam; common, fine, faint, gray (5Y 5/1) mottles and common, fine, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4 and 5/6) mottles; moderate, fine, subangular blocky structure; firm; numerous very dark brown (10YR 2/2) worm casts; clay films on surface of peds; less than 5 percent coarse fragments; mildly alkaline; clear, wavy boundary.

B22tg—16 to 26 inches, gray (5Y 5/1) clay loam; common, fine, faint, dark-gray (5Y 4/1) mottles and common, fine, distinct, dark-brown (7.5YR 4/4) and yellowish-brown (10YR 5/6) mottles; moderate, medium, angular blocky structure; firm; clay films on surface of peds; less than 5 percent coarse fragments; 3 percent cobblestones; mildly alkaline; abrupt, wavy boundary.

C1g—26 to 36 inches, mottled gray (5Y 6/1), light olive-gray (5Y 6/2), dark-gray (5Y 4/1), and yellowish-brown (10YR 5/4 and 5/6) loam; very weak, fine, subangular blocky structure; firm; less than 5 percent coarse fragments; mildly alkaline, slightly effervescent; gradual, wavy boundary.

C2g—36 to 51 inches, mottled gray (5Y 5/1), olive-gray (5Y 5/2), yellowish-brown (10YR 5/4), and light olive-brown (2.5Y 5/4) light clay loam; massive; firm; less than 5 percent coarse fragments; mildly alkaline, slightly effervescent; gradual, wavy boundary.

3g—51 to 60 inches, mottled grayish-brown (10YR 5/2), yellowish-brown (10YR 5/4), and strong-brown (7.5YR 5/6) heavy loam; massive; firm; less than 5 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum generally is 24 to 43 inches but ranges from 24 to 50 inches. The Ap horizon ranges from 8 to 12 inches in thickness and is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or very dark gray (10YR 3/1). There is a 1- to 3-inch, very dark gray (10YR 3/1) A12 horizon where the Ap horizon is less than 10 inches thick. The A horizon ranges from 10 to 14 inches in thickness. The B21tg horizon is clay loam or silty clay loam; the B22tg horizon is clay loam, heavy sandy clay loam, or clay loam. The C horizon is loam or light clay loam. It is mildly or moderately alkaline and slightly or strongly effervescent.

In Livingston County, these soils have an A horizon that is thinner than is defined as the range for the series, but this difference seems not to alter their usefulness and behavior.

Brookston soils are in a drainage sequence with Conover and Miami soils. They are similar to Barry, Berville, Breckenridge, and Pewamo soils. Brookston soils have a darker colored Ap horizon and are wetter than Conover and Miami soils. They have a finer textured B horizon than Barry, Berville, and Breckenridge soils. They are coarser textured throughout than Pewamo soils.

Brookston loam (0 to 2 percent slopes) (By).—This soil is in depressions and drainageways on till plains and moraines. In a few isolated areas, the underlying material is silty.

Included with this soil in mapping are small, slightly higher areas in which there are somewhat poorly drained Conover soils and small depressions in which there are very poorly drained Linwood and Carlisle soils.

Surface runoff is very slow, permeability is moderately slow, and the erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

If adequately drained, this soil is well suited to the commonly grown crops, especially row crops. It is moderately well suited as woodland. Capability unit IIw-4 (2.5c); woodland suitability group 3w3.

Carlisle Series

The Carlisle series consists of nearly level, very poorly drained soils. These soils are in depressions on moraines and till plains and occur as wide strips in glacial drainageways and in slack water areas adjacent to lakes, streams, and rivers. They formed in deep organic material.

In a representative profile the surface layer is black muck 23 inches thick. The underlying material is brown muck that is a mixture of raw fibers, peaty sedge materials, and woody fragments.

Permeability is moderately rapid. The available water capacity is very high, and fertility is low. Surface runoff is very slow to ponded.

If drained and protected from soil blowing, the Carlisle soils are moderately well suited to farming, particularly to row crops. They are poorly suited as woodland. They have severe limitations for most nonfarm uses.

Representative profile of Carlisle muck, in a wooded area in NE¼NE¼ sec. 12, T. 2 N., R. 3 E.:

1—0 to 23 inches, black (10YR 2/1) muck; moderate, coarse, subangular blocky structure in the upper 10 inches, moderate, medium, granular structure in the lower part; friable; common, fine and medium, partially decomposed wood fragments that disintegrate easily with slight rubbing in the upper part and partially decomposed fibers from grasses and sedges in the lower part; neutral.

2—23 to 48 inches, brown (7.5YR 4/4) muck; massive; friable; mixture of raw fibers, peaty sedge material, and wood fragments that disintegrate with hard rubbing; neutral.

The reaction throughout the soil is slightly acid or neutral. Woody material makes up as much as 20 percent of the volume in the upper horizon. The fibrous material is too well decomposed and finely divided for accurate identification of plant species. The amount of wood material increases with depth, ranging to a maximum of 50 percent in the 2 horizon.

In Livingston County, these soils have a subhorizon that is brighter colored than is defined as the range for the series, but the difference seems not to alter their usefulness and behavior.

Carlisle soils are similar to Edwards, Linwood, Tawas, and Rifle soils. Carlisle soils have thicker organic material than Edwards, Linwood, and Tawas soils, which are underlain at a depth of less than 42 inches with marl, loamy material, and sandy material, respectively. Carlisle soils are more decomposed in the subhorizons than Rifle soils.

Carlisle muck (0 to 2 percent slopes) (Cc).—This soil is in 2- to 200-acre tracts in depressed areas of till plains, moraines, glacial drainageways, and lake plains.

Included in mapping are narrow strips of Tawas or Linwood soils that lie between this Carlisle soil and the surrounding mineral soils on uplands. In the eastern half of the county, many small areas of Tawas soils are included. These soils are underlain by coarse-textured material at depths of 12 to 40 inches. A few small spots of Linwood and Tawas soils are included in other areas of Carlisle muck, but they make up less than 20 percent of the area. Small areas in which there are moderately coarse textured and medium-textured mineral soils are included in some of the larger tracts. They occur on small knoll-like

islands and narrow low ridges, and they make up less than 10 percent of the area.

Surface runoff is very slow to ponded, permeability is moderately rapid, and the hazard of soil blowing is severe. The principal concerns of management are maintaining adequate drainage, controlling erosion, and maintaining fertility.

Vegetable crops, sugar beets, and corn are grown on this soil. In some parts of the county, the soil has been successfully used for sod crops. If it is adequately drained and protected from soil blowing, it is moderately well suited to farming, particularly to row crops. It is poorly suited as woodland. Capability unit IIIw-15 (Mc); woodland suitability group -w1.

Colwood Series

The Colwood series consists of nearly level, poorly drained soils on lake plains. These soils formed in stratified silt loam and silty clay loam.

In a representative profile the surface layer is black and very dark gray fine sandy loam 13 inches thick. The upper part of the subsoil is dark-gray, friable loam that is mottled with yellowish brown, dark grayish brown, and dark yellowish brown and is 4 inches thick. The middle part is dark-gray, friable loam that is mottled with gray, dark grayish brown, and yellowish brown and is 5 inches thick. The lower part is olive-gray, friable silt loam that is mottled with yellowish brown. It is 4 inches thick. The underlying material, at a depth of 26 inches, consists of layers of silty clay loam and silt loam. They are grayish brown, dark grayish brown, or olive gray in color and are mottled with strong brown, olive, and brown.

Permeability is moderate. The available water capacity and fertility are high. Surface runoff is very slow.

If drained, Colwood soils are well suited to farming, particularly to row crops. They are poorly suited as woodland. They have severe limitations for most nonfarm uses.

Representative profile of Colwood fine sandy loam, in a cultivated field in SW¼SW¼NE¼ sec. 15, T. 4 N., R. 3 E.:

Ap—0 to 9 inches, black (10YR 2/1) fine sandy loam; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

A12—9 to 13 inches, very dark gray (10YR 3/1) fine sandy loam; weak, medium, granular structure; very friable; slightly acid; abrupt, wavy boundary.

IIB21g—13 to 17 inches, dark-gray (5Y 4/1) loam; many, medium, distinct, yellowish-brown (10YR 5/6), dark grayish-brown (10YR 4/2), and dark yellowish-brown (10YR 4/4) mottles; weak, medium, platy structure; friable; neutral; abrupt, wavy boundary.

IIB22g—17 to 22 inches, dark-gray (5Y 4/1) loam; many, medium, distinct, gray (10YR 5/1), dark grayish-brown (10YR 4/2), and yellowish-brown (10YR 5/8) mottles; weak, medium, platy structure; friable; mildly alkaline; abrupt, wavy boundary.

IIIB23g—22 to 26 inches, olive-gray (5Y 5/2) silt loam; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; mildly alkaline; abrupt, wavy boundary.

IVC1g—26 to 36 inches, grayish-brown (2.5Y 5/2) silty clay loam; many, fine, prominent, strong-brown (7.5YR 5/6) mottles; weak, coarse, subangular blocky structure; friable; mildly alkaline, slightly effervescent; abrupt, wavy boundary.

IVC2g—36 to 43 inches, olive-gray (5Y 5/2) silt loam; many, medium, distinct, olive (5Y 5/4) mottles; massive; firm; mildly alkaline, slightly effervescent; abrupt, wavy boundary.

IVC3g—43 to 60 inches, dark grayish-brown (2.5Y 4/2) silty clay loam; common, medium, prominent, brown (7.5YR 5/4) mottles; massive; firm; mildly alkaline, slightly effervescent.

The thickness of the solum generally is 26 to 36 inches and ranges from 24 to 49 inches. The Ap horizon ranges from 8 to 14 inches in thickness. In a few profiles it contains up to 10 percent organic matter. The Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). If the Ap horizon is less than 10 inches thick, the A12 horizon is 1 to 4 inches thick. In a few profiles the B horizon contains strata that are ¼ inch to 10 inches thick. The strata range from sand to silty clay loam but generally are very fine sandy loam or silty clay loam. The B horizon is neutral or mildly alkaline. In a few profiles the lower part of the B horizon is slightly effervescent. The individual C horizons range from 2 to 17 inches in thickness. They are generally silt loam and silty clay but range from sand to silty clay. The C horizons are mildly or moderately alkaline and are slightly or strongly effervescent.

In Livingston County, the C horizon of these soils has a finer texture than that defined as the range for the series, but this difference seems not to alter their usefulness and behavior.

Colwood soils are similar to Lamson and Sebewa soils. They have a finer textured B horizon than Lamson soils and a finer textured C horizon than Sebewa soils.

Colwood fine sandy loam (0 to 2 percent slopes) (Cr).—This soil is in depressional areas on lake plains.

Included with this soil in mapping are some areas that have gravel in the underlying layers. Also included are some small areas of lighter colored and better drained soils that are similar to the Colwood soils in texture. These included soils occur in slightly raised areas.

Surface runoff is very slow, permeability is moderate, and the erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

If adequately drained, this soil is well suited to the crops commonly grown in the county, particularly to row crops. It is poorly suited as woodland. Capability unit IIw-4 (2.5c); woodland suitability group 4w3.

Conover Series

The Conover series consists of nearly level or gently sloping, somewhat poorly drained soils on till plains and moraines. These soils formed in loam and light clay loam till. In Livingston County, Conover soils are mapped alone and in a complex with Miami soils.

In a representative profile the surface layer is very dark grayish-brown loam 9 inches thick. The subsurface layer is 4 inches thick and is brown heavy loam mottled with yellowish brown and pale brown. The upper part of the subsoil is mottled yellowish-brown and grayish-brown, firm clay loam that is 12 inches thick. The lower part of the subsoil is mottled yellowish-brown, dark-brown, grayish-brown, and pale-brown, firm light clay loam that is 9 inches thick. The underlying material begins at a depth of 34 inches. It is mottled yellowish-brown, brown, grayish-brown, and light grayish-brown light clay loam that grades to loam as depth increases.

Permeability is moderately slow. The available water capacity and fertility are high. Surface runoff is slow.

If drained, Conover soils are well suited to farming. They are moderately well suited as woodland. They have moderate to severe limitations for nonfarm uses.

Representative profile of Conover loam, 0 to 2 percent slopes, in a cultivated field in SE¼NE¼NE¼ sec. 21, T. 3 N., R. 3 E.:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loam; very weak, medium, granular structure; very friable; less than 5 percent coarse fragments; slightly acid; abrupt, smooth boundary.

A2—9 to 13 inches, brown (10YR 5/3) heavy loam; common, fine, faint, yellowish-brown (10YR 5/5 and 5/6) and pale-brown (10YR 6/3) mottles; weak, fine, subangular blocky structure; friable; contains many dark grayish-brown (10YR 4/2) worm casts and coatings along root channels; numerous isolated peds of light clay loam from the B21t horizon; less than 5 percent coarse fragments; slightly acid; clear, irregular boundary.

B21t—13 to 25 inches, mottled yellowish-brown (10YR 5/4 and 5/6) and grayish-brown (10YR 5/2) clay loam; weak, medium, subangular blocky structure; firm; few thin streaks and specks of dark brown (7.5YR 3/2); dark grayish-brown (10YR 4/2) clay films on surface of peds and along root channels; less than 5 percent coarse fragments; medium acid; gradual, wavy boundary.

B22t—25 to 34 inches, mottled yellowish-brown (10YR 5/6 and 5/8), dark-brown (10YR 4/3), grayish-brown (10 YR 5/2), and pale-brown (10YR 6/3) light clay loam; weak, coarse, subangular blocky structure; firm; brown (10YR 4/3) clay films on surface of peds and dark-gray (10YR 4/1) clay films along cracks and root channels; less than 5 percent coarse fragments; medium acid; abrupt, irregular boundary.

C1—34 to 41 inches, mottled yellowish-brown (10YR 5/6), brown (10YR 5/3), and grayish-brown (10YR 5/2), light clay loam; weak, coarse, subangular blocky structure; firm; few nearly vertical cracks and root channels lined with dark grayish-brown (10YR 4/2) clay films; less than 5 percent coarse fragments; mildly alkaline, slightly effervescent; abrupt, irregular boundary.

C2—41 to 60 inches, mottled yellowish-brown (10YR 5/8), brown (10YR 5/3), grayish-brown (10YR 5/2), and light brownish-gray (2.5Y 6/2), loam; very weak, coarse, subangular blocky structure; friable; few root channels or cracks lined with grayish-brown (10YR 5/2) clay films; less than 5 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum generally is 24 to 35 inches but ranges from 24 to 40 inches. The Ap horizon ranges from 7 to 10 inches in thickness and is very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), or very dark brown (10YR 2/2). The B22t horizon is sandy clay loam or clay loam. In a few profiles there is a B23t horizon that is neutral to mildly alkaline. The C horizon is loam and light clay loam within short vertical and horizontal distances. It is mildly or moderately alkaline and slightly or strongly effervescent.

Conover soils are in a drainage sequence with Miami and Brookston soils and are mapped in a complex with Miami soils. They are similar to Locke and Metamora soils and are associated with Pewamo soils. They are more poorly drained than Miami soils and better drained than Brookston soils. Conover soils dominantly are finer textured in the solum than are Locke and Metamora soils. They have a lighter colored Ap horizon and are better drained than the associated Pewamo soils.

Conover loam, 0 to 2 percent slopes (CvA).—This soil is on till plains and in basinlike depressions in the hilly moraines. It has the profile described as representative for the series.

Included with this soil in mapping are some small areas in the northeastern part of the country that have a heavy silty clay loam subsoil. Also included are small areas of Metea and Metamora soils that are coarser textured in the surface layer and upper part of the subsoil than this Conover soil. Poorly drained Brookston soils and very poorly drained Carlisle soils are included in small, wet, depressional areas.

Surface runoff is slow, permeability is moderately slow, and the erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

This soil is well suited to crops commonly grown in the county. It is moderately well suited as woodland. Capability unit IIw–4 (2.5b); woodland suitability group 3w1.

Conover loam, 2 to 6 percent slopes (CvB).—This soil is on till plains and low moraines.

Included with this soil in mapping are some areas of soils in the northeastern part of the county that have a heavy silty clay loam subsoil. Included in drainageways are small areas of poorly drained Brookston soils, which are wetter than this Conover soil. Small areas of well-drained Miami soils are included on knolls.

Surface runoff is slow, permeability is moderately slow, and the erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

This soil is well suited to the crops commonly grown in the county. It is moderately well suited as woodland. Capability unit IIw–5 (2.5b); woodland suitability group 3w1.

Conover-Miami loams, 0 to 2 percent slopes (CxA).—This complex is on till plains. It is made up of areas of somewhat poorly drained Conover soil and well-drained Miami soil that are so small and so intricately intermingled that it is not practical to map them separately. Conover loam is in slightly lower areas than Miami loam. The Conover soil makes up about 55 to 65 percent of the complex, and the Miami soil makes up about 35 to 45 percent.

Surface runoff is slow, permeability is moderately slow, and the erosion hazard is slight. The principal concern of management is maintaining adequate drainage on the Conover soil.

These soils are well suited to the crops common in the county. The Conover soil is moderately well suited as woodland, and the Miami soil is well suited. Capability unit IIw–4 (2.5a, 2.5b); woodland suitability groups 3wl for the Conover soil and 2ol for the Miami soil.

Edwards Series

The Edwards series consists of nearly level, very poorly drained soils. These soils occupy depressional areas on moraines, on broad outwash plains, in glacial drainageways, and in slack water areas adjacent to lakes. They formed in 12 to 40 inches of organic material underlain by marl.

In a representative profile the surface layer is black muck 19 inches thick. The underlying material is gray marl that contains shell fragments.

Permeability is variable. The available water capacity is high, and fertility is low. Surface runoff is very slow to ponded.

The Edwards soils are poorly suited to farming and

as woodland. They have severe limitations for most nonfarm uses.

Representative profile of Edwards muck, in a wooded area in SE¼SE¼ sec. 1, T. 2 N., R. 3 E.:

1—0 to 19 inches, black (10YR 2/1) muck; moderate, medium, granular structure; friable; few woody fragments that break down under rubbing; neutral; abrupt, smooth boundary.

IIC—19 to 48 inches, gray (5Y 5/1) marl; massive; friable; contains numerous shell fragments; moderately alkaline, violently effervescent.

The organic material is 12 to 40 inches thick over marl. In a few profiles a stratum of sandy loam, loamy sand, or gravelly counterparts of these textures is between the muck and marl. The mineral material in this stratum is mildly or moderately alkaline and slightly or strongly effervescent. The marl is gray (5Y 5/1 or 10YR 6/1), and contains up to 50 percent mineral material.

Edwards soils are similar to Carlisle, Tawas, Linwood, and Warners soils. They have thinner organic material than Carlisle soils, which are more than 42 inches deep. They are underlain with marl instead of sandy or loamy material, which underlies Tawas and Linwood soils, respectively. Edwards soils are deeper to marl than Warners soils.

Edwards muck (0 to 2 percent slopes) (Ed).—This soil is in small depressional areas on moraines and larger depressional areas on outwash plains and in glacial drainageways.

Small areas in which marl is in the surface layer occur in some places. Included in mapping are small areas of shallow Warners soils which have 12 inches or less of organic or mineral material over marl. Small islands of mineral soils are included in some of the larger areas of Edwards muck.

Surface runoff is very slow to ponded, permeability is variable, and the erosion hazard is moderate. The principal limitations that affect management are wetness, low fertility, soil blowing, and the generally poor physical and chemical properties of the underlying marl.

This soil is poorly suited as cropland and woodland. Capability unit IVw–6 (M/mc); woodland suitability group –w1.

Fox Series

The Fox series consists of nearly level to very steep, well-drained sandy soils on outwash plains, valley trains, and moraines. These soils formed in sandy loam and loam material. In Livingston County, Fox soils are mapped alone and in complexes with Boyer soils.

In a representative profile the surface layer is dark-brown sandy loam 9 inches thick. The subsurface layer is brown sandy loam 4 inches thick. The upper part of the subsoil is dark-brown, firm light sandy clay loam 11 inches thick. The middle part is reddish-brown, firm heavy sandy clay loam 10 inches thick. The lower part is reddish-brown, firm gravelly loam 2 inches thick. The underlying material, beginning at a depth of 36 inches, is brown gravelly sand.

Permeability is moderate. The available water capacity is moderate, and fertility is medium. Surface runoff is slow to rapid.

The nearly level to gently sloping Fox soils are well suited to farming and as woodland. In areas where slopes are less than 12 percent, Fox soils have only slight limitations for most nonfarm uses.

Representative profile of Fox sandy loam, 2 to 6 percent slopes, in a cultivated field in NE¼NE¼NE¼ sec. 25, T. 4 N., R. 3 E.:

Ap—0 to 9 inches, dark-brown (10YR 3/3) sandy loam, brown (10YR 4/3) crushed; moderate, fine, granular structure; friable; less than 10 percent coarse fragments; neutral; abrupt, smooth boundary.

A2—9 to 13 inches, brown (10YR 5/3) sandy loam; weak, coarse, subangular blocky structure; friable; less than 10 percent coarse fragments; slightly acid; clear, wavy boundary.

B21t—13 to 24 inches, brown (7.5YR 4/4) light sandy clay loam; moderate, medium, subangular blocky structure; clay bridges connect sand grains; less than 10 percent coarse fragments; slightly acid; gradual, wavy boundary.

B22t—24 to 34 inches, reddish-brown (5YR 4/4) heavy sandy clay loam; moderate, medium, subangular blocky structure; clay films on surface of peds; less than 10 percent coarse fragments; medium acid; abrupt, irregular boundary.

B23t—34 to 36 inches, reddish-brown (5YR 5/3) gravelly loam; weak, fine, subangular blocky structure; firm; clay films on surfaces of peds; 20 percent coarse fragments; neutral; abrupt, irregular boundary.

IIC—36 to 60 inches, brown (10YR 5/3) gravelly sand; single grain; loose; 30 percent coarse fragments; mildly alkaline; slightly effervescent.

The thickness of the solum generally is 32 to 40 inches. Reaction throughout the solum ranges from medium acid to neutral. A few soil profiles have an A1 horizon that is very dark grayish brown (10YR 3/2). The Ap horizon is dark brown (10YR 3/3) or dark grayish brown (10YR 4/2). The A2 horizon is brown (10YR 5/3), light gray (10YR 7/2), or light brownish gray (10YR 6/2). In a few profiles chunks of B21t horizon are in the A2 horizon. In a few profiles tongues of B23t horizon extend downward into the IIC horizon. The thickness and frequency of the tongues are variable, but a few extend to a depth of 2 or 3 feet. The B22t horizon is sandy clay loam to clay loam. The C horizon is mildly or moderately alkaline and slightly or strongly effervescent.

Fox soils are mapped in complexes with Boyer soils. They are similar to Oshtemo and Hillsdale soils. Fox soils dominantly have a finer textured B horizon than Boyer and Oshtemo soils. They have a coarser textured C horizon than Hillsdale soils.

Fox sandy loam, 0 to 2 percent slopes (FoA).—This soil is on outwash plains, valley trains, and low moraines in areas of 10 to 60 acres.

Small areas of Boyer and Oshtemo soils are included with this soil in mapping. These soils are coarser textured in the upper part of the subsoil and are more droughty than Fox soils. On the low moraines, small areas of finer textured Miami soils are included. Small depressions in which there are somewhat poorly drained Wasepi soils and very poorly drained Gilford soils also are included. Other inclusions are small areas where slopes are as much as 18 percent or, in a few places, are steeper.

Runoff is slow, permeability is moderate, and the erosion hazard is slight.The principal concern of management is moisture conservation.

Many areas are now used for residential purposes or have been developed for recreation. This soil is well suited to the crops commonly grown in the county. It is well suited as woodland. Capability unit IIs–2 (3a); woodland suitability group 2o1.

Fox sandy loam, 2 to 6 percent slopes (FoB).—This soil is on outwash plains, valley trains, and moraines in areas of 10 to 60 acres. The larger areas are on outwash

plains. This soil has the profile described as representative for the series.

A few small areas have a yellowish-brown surface layer. These included areas are intermingled with areas having a brown surface layer. Also included in mapping are small areas of more droughty Boyer and Oshtemo soils and small areas of finer textured Miami soils. These inclusions are more common in the morainic areas than in the outwash plain areas. Small depressions in which there are somewhat poorly drained Wasepi soil also are included. Other inclusions are small areas having slopes of as much as 18 percent, and a few areas having slopes of more than 18 percent.

Surface runoff is slow, permeability is moderate, and the erosion hazard is slight. The principal concerns of management on this soil are erosion control and moisture conservation.

A large acreage in the southeastern part of the county is used for residential development or recreation. This soil is well suited to the crops commonly grown in the county. It also is well suited as woodland. Capability unit IIe-3 (3a); woodland suitability group 2o1.

Fox sandy loam, 6 to 12 percent slopes (FoC).—This soil is on outwash plains and moraines in areas of 5 to 40 acres. On the outwash plains, it borders pits, potholes, and marshes.

Included with this soil in mapping are some areas that have a yellowish-brown or reddish-brown sandy clay loam surface layer. These areas are small and are intermingled with areas having a dark-brown surface layer. Small areas of more droughty Boyer and Oshtemo soils are included. These areas occur more commonly on moraines than on outwash plains. A few small depressions in which there are poorly drained Sebewa soils also are included. Other inclusions are small areas having slopes of 12 to 18 percent or, in a few places, more than 18 percent.

Surface runoff is medium, permeability is moderate, and the erosion hazard is moderate. The principal concern in management is control of erosion.

This soil is moderately well suited to crops commonly grown in the county. It is well suited to woodland. Capability unit IIIe-6 (3a); woodland suitability group 2o1.

Fox-Boyer complex, 2 to 6 percent slopes (FrB).—The soils in this complex are on outwash plains, valley trains, and moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. Fox sandy loam makes up about 50 percent of the complex, and Boyer loamy sand about 40 percent. The Fox soil has a thinner and coarser textured profile than that described as representative for the series.

Included with this complex in mapping are small areas that have a yellowish-brown or reddish-brown surface layer. Some small areas of finer textured Miami and Owosso soils and coarser textured Spinks-Oakville loamy sands are included, as well as a few small depressions in which there are very poorly drained Gilford soils. Also included are small areas that have slopes of 6 to 18 percent and a few areas that have slopes exceeding 18 percent.

Surface runoff is slow. Permeability is moderate for the Fox soil and moderately rapid for the Boyer soil. The erosion hazard is slight. The principal concern of management is moisture conservation.

These soils are moderately well suited as cropland. The Fox soil is well suited as woodland and the Boyer soil is moderately well suited. Capability unit IIIs-4 (3a, 4a); woodland suitability groups 2o1 for Fox soil and 3s5 for Boyer soil.

Fox-Boyer complex, 6 to 12 percent slopes (FrC).—The soils in this complex are on outwash plains, valley trains, and moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. Fox sandy loam makes up about 50 percent of the complex, and Boyer loamy sand about 35 percent. The Fox soil has a thinner, coarser textured profile than that described as representative for the series.

Included with this complex in mapping are small areas that have a surface layer of yellowish-brown or reddish-brown sandy clay loam. Small areas of coarser textured Spinks-Oakville loamy sands are included, as well as small areas of finer textured Miami soils. Small depressions in which there are somewhat poorly drained Brady and very poorly drained Gilford soils are also included. On the moraines, small areas that have slopes of 12 to 18 percent are included, as well as small areas having slopes of more than 18 percent.

Surface runoff is medium. Permeability is moderate for the Fox soil and moderately rapid for the Boyer soil. The erosion hazard is moderate. The principal concern of management is erosion control.

These soils are moderately well suited to the crops commonly grown in the county. The Fox soil is well suited as woodland and the Boyer soil is moderately well suited. Capability unit IIIe-9 (3a, 4a); woodland suitability groups 2o1 for Fox soil and 3s5 for Boyer soil.

Fox-Boyer complex, 12 to 18 percent slopes (FrD).—The soils in this complex are on moraines and outwash plains. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. Fox sandy loam makes up about 50 percent of the complex, and Boyer loamy sand about 35 percent. The Fox soil in this complex has a thinner and coarser textured profile than that described as representative for the series.

Included with this complex in mapping are small areas that have a yellowish-brown or reddish-brown sandy clay loam surface layer. These areas are intermingled with areas having a dark-brown surface layer. Small areas of coarser textured Spinks-Oakville loamy sands are included, as well as small areas of Hillsdale soils, which lack the sand and gravel underlying material. Also included are small depressions in which there are somewhat poorly drained Brady and very poorly drained Gilford soils. Small areas that have steeper slopes are included.

Surface runoff is rapid. Permeability is moderate for the Fox soil and moderately rapid for the Boyer soil. The erosion hazard is severe. The principal concern of management is erosion control.

These soils are poorly suited as cropland because of slope. The Fox soil is well suited as woodland, and the Boyer soil is moderately well suited. Gravel pits are common in these soils. Capability unit IVe-9 (3a, 4a); woodland suitability groups 2o1 for Fox soil and 3s5 for Boyer soil.

Fox-Boyer complex, 18 to 25 percent slopes (FrE).—Soils in this complex are on moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. Fox sandy loam makes up about 45 percent of the complex, and Boyer loamy sand about 40 percent. The profile of the Fox soil is thinner and coarser textured than that described as representative for the series. In a few areas the surface layer is yellowish-brown or reddish-brown sandy clay loam.

Included with this complex in mapping are small areas of coarser textured Spinks-Oakville loamy sands and finer textured Hillsdale soils. Small depressions in which there are very poorly drained Gilford and Tawas soils are included.

Surface runoff is rapid. Permeability is moderate for the Fox soil and moderately rapid for the Boyer soil. The erosion hazard is severe. The principal concern of management on these soils is erosion control.

Many areas were once cleared for farming but are now idle and growing up to grass, weeds, and brush. These soils are not suited as cropland, because of slope. The Fox soil is well suited as woodland, but there are moderate limitations because of slope. The Boyer soil is moderately well suited as woodland. Small gravel pits are common in areas of these soils. Capability unit VIe-2 (3a, 4a); woodland suitability groups 2o2 for Fox soil and 3s6 for Boyer soil.

Fox-Boyer complex, 25 to 40 percent slopes (FrF).—Soils in this complex are on moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. Fox sandy loam makes up about 45 percent of the complex, and Boyer loamy sand about 40 percent. The profile of the Fox soil is thinner and coarser textured than that described as representative for the series. A few areas have a yellowish-brown or reddish-brown sandy clay loam surface layer. In a few places these areas make up most of the mapping unit, but in others they are intermingled with areas that have a dark-brown surface layer.

Included with this complex in mapping are small areas of coarser textured Spinks-Oakville loamy sands and finer textured Hillsdale soils.

Surface runoff is rapid. Permeability is moderate for the Fox soil and moderately rapid for the Boyer soil. The erosion hazard is severe. The principal concern of management is erosion control.

Most areas that were cleared for farming are now idle and growing up to grass, weeds, and brush. These soils are not suited as cropland, because of the steep slopes. The Fox soil is well suited as woodland, but there are moderate limitations because of slope. The Boyer soil is moderately well suited as woodland. Capability unit VIIe-2 (3a, 4a); woodland suitability groups 2o2 for Fox soil and 3s6 for Boyer soil.

Gilford Series

The Gilford series consists of nearly level, very poorly drained soils on outwash plains, lake plains, and valley trains. These soils formed in loamy sand.

In a representative profile the surface layer is very dark gray sandy loam 12 inches thick. The upper part of the subsoil is dark grayish-brown, friable sandy loam that is mottled with brownish yellow and is 12 inches thick. The middle part is grayish-brown, friable sandy clay loam that is mottled with brownish yellow and is 6 inches thick. The lower part is light brownish-gray, friable sandy loam that is mottled with brownish yellow. It is 6 inches thick. The underlying material, at a depth of 36 inches, is gray gravelly sand.

Permeability is moderately rapid. The available water capacity is low, and fertility is medium. Surface runoff is very slow.

Gilford soils are moderately well suited to farming, particularly to row crops. They are poorly suited as woodland. They have severe limitations for most nonfarm uses.

Representative profile of Gilford sandy loam, in a cultivated field in NE¼SW¼ sec. 3, T. 1 N., R. 3 E.:

Ap—0 to 12 inches, very dark gray (10YR 3/1) sandy loam; moderate, medium, granular structure; friable; less than 10 percent coarse fragments; slightly acid; abrupt, smooth boundary.

B21g—12 to 24 inches, dark grayish-brown (10YR 4/2) sandy loam; common, fine, distinct, brownish-yellow (10YR 6/8) mottles; weak, coarse, subangular blocky structure; friable; less than 10 percent coarse fragments; medium acid; clear, wavy boundary.

B22tg—24 to 30 inches, grayish-brown (10YR 5/2) sandy clay loam; common, fine, distinct, brownish-yellow (10YR 6/8) mottles; moderate, coarse, subangular blocky structure; friable; less than 10 percent coarse fragments; strongly acid; clear, wavy boundary.

B23g—30 to 36 inches, light brownish-gray (10YR 6/2) sandy loam; common, medium, distinct, brownish-yellow (10YR 6/6) mottles; weak, coarse, subangular blocky structure; friable; less than 10 percent coarse fragments; medium acid; abrupt, irregular boundary.

IICg—36 to 60 inches, gray (10YR 6/1) gravelly sand; single grain; loose; 30 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum generally ranges from 26 to 44 inches. The Ap horizon is 10 to 14 inches thick and is very dark gray (10YR 3/1) or black (10YR 2/1). The Bg horizon is dark gray (10YR 4/1) or dark grayish brown (10YR 4/2), gray (10YR 5/1 or 6/1) to grayish brown (10YR 5/2), or light brownish gray (10YR 6/2). It is sandy loam or sandy clay loam. The IICg horizon is sand or gravelly sand. It is mildly or moderately alkaline and slightly or strongly effervescent.

In Livingston County, the first subhorizon of these soils has less gray than is within the range defined for the series, but this difference seems not to alter the usefulness and behavior of the soils.

Gilford soils occupy depressions and low-lying areas adjacent to the well-drained Boyer and Oshtemo soils and the somewhat poorly drained Brady soils. They are similar to Sebewa soils. Gilford soils have a darker colored Ap horizon and are wetter than Boyer, Oshtemo, and Brady soils. Gilford soils have a dominantly coarser textured B horizon than Sebewa soils.

Gilford sandy loam (0 to 2 percent slopes) (Gd).—This soil is in irregularly shaped areas on outwash plains, valley trains, and lake plains.

Included with this soil in mapping are small areas of somewhat poorly drained Brady soils. The Brady soils are in the higher areas and have better surface and internal drainage than this Gilford soil. Small areas of deep sandy material are included. Small depressions in which there are very poorly drained Tawas and Houghton soils are also included.

Runoff is very slow, permeability is moderately rapid, and the erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

If adequately drained, this soil is moderately well suited to the crops commonly grown in the county, particularly row crops. It is poorly suited as woodland. Capability unit IIIw-5 (4c); woodland suitability group 4w3.

Gravel Pits

Gravel pits (Gr) are areas from which the upper layers of soil material have been removed or pushed aside and gravel containing variable amounts of sand has been excavated (fig. 3). The pits are scattered throughout the county. Sand and gravel are used mainly as fill material for highway construction and in the manufacture of concrete products. Gravel pits vary considerably in size. The larger pits are outlined on the soil map, but the small areas, generally less than 2 acres in size, are shown by special spot symbols. Some of the pits contain water. Some are a source of water for irrigation, and some are suitable for recreational uses. Capability unit VIIIs-1; not in a woodland suitability group.

Figure 3.—Gravel pit in area of Fox soils. Fox soils are a good potential source of sand and gravel.

Hillsdale Series

The Hillsdale series consists of gently sloping to steep, well-drained soils on till plains and moraines. These soils formed in sandy loam till. In Livingston County, Hillsdale soils are mapped alone and in complexes with Miami soils.

In a representative profile the surface layer is very dark grayish-brown sandy loam 10 inches thick. The subsurface layer is dark grayish-brown sandy loam 6 inches thick. The upper part of the subsoil is brown, friable sandy loam 5 inches thick. The second part is yellowish-brown, friable light sandy clay loam 17 inches thick. The third part is yellowish-brown, friable sandy loam 12 inches thick. The fourth part is brown, friable sandy loam 15 inches thick. The underlying material, at a depth of 65 inches, is brown sandy loam.

Permeability is moderate. The available water capacity is moderate, and fertility is medium. Surface runoff is slow to rapid.

The nearly level to gently sloping Hillsdale soils are well suited to farming. They are moderately well suited as woodland. Where slopes are 12 percent or less, Hillsdale soils have slight limitations for many nonfarm uses.

Representative profile of Hillsdale sandy loam, 2 to 6 percent slopes, in a cultivated field in SE¼SE¼SW¼ sec. 30, T. 1 N., R. 3 E.:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) sandy loam, brown (10YR 4/3) rubbed; weak, fine, granular structure; friable; 10 percent coarse fragments; neutral; abrupt, smooth boundary.

A2—10 to 16 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, thin, platy structure; very friable; dark-gray (10YR 4/1) worm casts and root channels; 10 percent coarse fragments; slightly acid; gradual, wavy boundary.

B1—16 to 21 inches, brown (10YR 5/3) sandy loam; weak, fine, subangular blocky structure; friable; 10 percent coarse fragments; medium acid; clear, wavy boundary.

B21t—21 to 38 inches, yellowish-brown (10YR 5/4) light sandy clay loam; moderate, medium, subangular blocky structure; friable; clay films on surfaces of peds; 10 percent coarse fragments; strongly acid; clear, wavy boundary.

B22t—38 to 50 inches, yellowish-brown (10YR 5/4) sandy loam; moderate, medium, subangular blocky structure; friable; clay bridges connect sand grains; 10 percent coarse fragments; strongly acid; clear, wavy boundary.

B3—50 to 65 inches, brown (10YR 5/3) sandy loam; weak, medium, subangular blocky structure; friable; 10 percent coarse fragments; medium acid; gradual, wavy boundary.

C—65 to 70 inches, brown (10YR 5/3) sandy loam; massive; friable; 10 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum generally is 44 to 80 inches. The Ap horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or dark brown (10YR 3/3). The Ap horizon is slightly acid or neutral. The B22t horizon is sandy loam, sandy clay loam, or light clay loam. The Bt horizon is brown (10YR 5/3), yellowish brown (10YR 5/4 and 5/6), dark yellowish brown (10YR 4/4), or dark brown (7.5YR 4/4). The B horizon ranges from slightly acid to strongly acid. The C horizon is loamy sand or sandy loam. It is mildly or moderately alkaline and slightly or strongly effervescent.

Hillsdale soils are mapped in complexes with Miami soils and are in a drainage sequence with Locke and Barry soils. They are similar to Fox soils, but they have a finer textured C horizon than those soils. They have a coarser textured B horizon than Miami soils. They have a lighter colored Ap horizon and are better drained than Locke and Barry soils.

Hillsdale loamy sand, 2 to 6 percent slopes (HdB).—This soil is in small areas on till plains and moraines. Its profile differs from that described as representative for the series by having a loamy sand surface layer.

Included in mapping are many areas of a soil that is similar to this Hillsdale soil but is underlain by sand, loamy sand, loamy fine sand, and fine sand that contain thin layers of silt. This included soil is extensive in those areas on moraines and till plains that border glacial drainageways. Also included are small areas of coarser textured Spinks-Oakville loamy sands.

Surface runoff is slow, permeability is moderate, and the erosion hazard is slight. The principal concern of management is erosion control.

This soil is well suited to the crops commonly grown in the county. It is moderately well suited as woodland. Capability unit IIe–3 (3a); woodland suitability group 3o3.

Hillsdale loamy sand, 6 to 12 percent slopes (HdC).—This soil is on short side slopes on till plains and moraines. Its profile commonly is similar to that described as representative for the series, except that it has a loamy sand surface layer.

Included in mapping are many areas of a soil that is similar to this Hillsdale soil but is underlain with loamy fine sand, fine sand, loamy sand, or sand at a depth of 24 to 42 inches. This included soil is extensive in areas that border glacial drainageways. Also included are small areas of coarser textured Spinks-Oakville loamy sands.

Surface runoff is medium, permeability is moderate, and the erosion hazard is moderate. The principal concern of management on this soil is erosion control.

This soil is moderately well suited to the common crops and as woodland. Capability unit IIIe–6 (3a); woodland suitability group 3o3.

Hillsdale sandy loam, 2 to 6 percent slopes (HlB).—This soil is on till plains and moraines. It has the profile described as representative for the series.

Included with this soil in mapping are some areas where the calcareous material lies at a depth of less than 40 inches and the underlying material is sand or fine sand. In some areas the surface layer is yellowish brown. Also included are small areas of the somewhat poorly drained Locke soils and very poorly drained Barry soils. These soils occur in depressions and drainageways. Small areas of the coarser textured Spinks-Oakville loamy sand are included. Some small areas that have slopes of 0 to 2 percent are included, as well as small areas that have slopes ranging from 6 to 18 percent.

Surface runoff is slow, permeability is moderate, and the erosion hazard is slight. The principal concern of management is erosion control.

Most of this soil is farmed, but small areas are in woodland. The soil is well suited to the crops commonly grown in the county. It is moderately well suited as woodland. Capability unit IIe–3 (3a); woodland suitability group 3o3.

Hillsdale sandy loam, 6 to 12 percent slopes (HlC).—This soil is on till plains and moraines. The surface layer is yellowish brown in some areas.

Included with this soil in mapping are small areas of coarser textured Spinks-Oakville loamy sands. Small areas that have steeper slopes are also included.

Surface runoff is medium, permeability is moderate, and the erosion hazard is moderate. The principal concern of management is erosion control.

This soil is moderately well suited to the crops common to the county. It is moderately well suited as woodland. Capability unit IIIe–6 (3a); woodland suitability group 3o3.

Hillsdale sandy loam, 12 to 18 percent slopes (HlD).—This soil is along natural drainageways on till plains and in small areas on moraines.

Included with this soil in mapping are small areas that have a yellowish-brown sandy clay loam surface layer. Also included are small areas of coarser textured Spinks-Oakville loamy sands and finer-textured Miami soils, as well as small depressions in which there are somewhat poorly drained Locke soils and very poorly drained Barry soils. Other inclusions are small areas that have steeper slopes.

Surface runoff is rapid, permeability is moderate, and the erosion hazard is severe. The principal concern of management is erosion control.

This soil is poorly suited as cropland because of slope. It is moderately well suited to small grain and hay, and it is moderately well suited as woodland. Capability unit IVe–4 (3a); woodland suitability group 3o3.

Hillsdale sandy loam, 18 to 25 percent slopes (HlE).—This soil is on moraines and along natural drainage channels on till plains.

Included with this soil in mapping are small areas where the surface layer is brown or yellowish-brown sandy clay loam or sandy loam. Small areas, irregular in shape, of the finer textured Miami soils are included. On hilltops and foot slopes are included small areas that have slopes of less than 10 percent, and a few small areas that have slopes of more than 25 percent. Small depressions in which there are wetter soils are also included.

Surface runoff is rapid, permeability is moderate, and the erosion hazard is severe. The principal concern of management is erosion control.

Most of this soil has been cleared but is now idle. A few areas have been planted to trees, and a small acreage is used for pasture. The soil is poorly suited as cropland and moderately well suited as woodland. Capability unit VIe–2 (3a); woodland suitability group 3o4.

Hillsdale-Miami loams, 2 to 6 percent slopes (HmB).—These soils are on moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. Hillsdale loam makes up 45 to 55 percent of the complex, and Miami loam makes up 30 to 40 percent.

Included with this complex in mapping, in small depressions and drainageways, are small, wet areas of somewhat poorly drained Conover and poorly drained Brookston soils. Small areas of coarser textured Spinks-Oakville loamy sands are also included. In addition, there are small included areas that have slopes greater than 6 percent, a few of which exceed 18 percent.

Surface runoff is slow, permeability is moderate, and the erosion hazard is slight. The principal concern of management is erosion control.

These soils are well suited to crops commonly grown in the county. The Hillsdale soil is moderately well suited as woodland, and the Miami soil is well suited. Capability unit IIe–2 (2.5a, 3a); woodland suitability groups 3o3 for Hillsdale soil and 2o1 for Miami soil.

Hillsdale-Miami loams, 6 to 12 percent slopes (HmC).—These soils are on moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. Hillsdale loam makes up 45 to 55 percent of the complex, and Miami loam makes up 30 to 40 percent.

Included with this complex in mapping are small areas that have a dark-brown or yellowish-brown surface layer. Also included, in depressions and drainageways, are small, wet areas of somewhat poorly drained Conover and poorly drained Brookston soils. Small areas of the coarser textured Spinks-Oakville loamy sands are included, and there are a few areas that have steeper slopes, some of which exceed 18 percent.

Surface runoff is medium, permeability is moderate, and the erosion hazard is moderate. The principal concern of management is erosion control.

These soils are moderately well suited to the crops commonly grown in the county. The Hillsdale soil is moderately well suited as woodland, and the Miami soil is well suited. Capability unit IIIe-5 (2.5a, 3a); woodland suitability groups 3o3 for Hillsdale soil and 2o1 for Miami soil.

Houghton Series

The Houghton series consists of nearly level, very poorly drained soils. These soils occupy depressions on moraines and occur as wide strips in glacial drainageways, on outwash plains, and in slack water areas adjacent to lakes. They formed in deep organic deposits.

In a representative profile the surface layer is black muck 5 inches thick. The underlying material is dark reddish-brown, friable, partially decomposed muck.

Permeability is moderately rapid. The available water capacity is very high. Fertility is low. Surface runoff is very slow to ponded.

If adequately drained, Houghton soils are moderately well suited to farming. They are poorly suited as woodland. They have severe limitations for most nonfarm uses.

Representative profile of Houghton muck, in NW¼NW¼SE¼ sec. 12, T. 3 N., R. 3 E.:

1—0 to 5 inches, black (10YR 2/1) muck; moderate, medium, granular structure; friable; strongly acid.

2—5 to 48 inches, dark reddish-brown (5YR 3/2) muck; moderate, medium, platy structure; friable; strongly acid.

The organic material is 42 inches or more thick. In a few profiles a 3- to 4-inch layer of sphagnum moss is on the soil surface. Woody fragments range from none to many throughout the profile. Reaction throughout the soil ranges from strongly acid to neutral.

Houghton soils are similar to Edwards, Linwood, Tawas, and Rifle soils. Houghton soils have thicker organic material than Edwards, Linwood, and Tawas soils, which are underlain at a depth of less than 42 inches by marl, loamy material, and sandy material, respectively. They are more decomposed in the subhorizons than the Rifle soils.

Houghton muck (0 to 2 percent slopes) (Ho).—This nearly level soil is in depressional areas on lake plains, outwash plains, glacial drainageways, and moraines. The areas range from 5 to 200 acres in size.

Included with this soil in mapping are strips of Linwood or Tawas soils that occur between Houghton muck and the adjacent mineral soils on uplands. Some small areas in which there are mineral soils are included. These occur mostly in the larger areas of this mapping unit and occupy knoll-like islands and narrow, long ridges. These included mineral soils make up less than 10 percent of the unit.

Surface runoff is very slow to ponded, permeability is moderately rapid, and the erosion hazard is moderate. The principal concerns of management are maintaining adequate drainage and control of soil blowing.

Only a few areas of this Houghton soil have been cleared and cultivated. Most areas are idle and swampy and are covered with marsh-type vegetation. If adequately drained and protected from soil blowing, this soil is moderately well suited to most row crops. It is poorly suited as woodland. Capability unit IIIw-15 (Mc); woodland suitability group -w1.

Lake Beaches

Lake beaches (La) consist of narrow, sandy and gravelly beaches that form the present shoreline of several large lakes. These beaches are constantly washed, shifted, and reworked by the action of waves, ice, and wind. They are generally nearly level to gently sloping. They support little or no vegetation near the edge of the water, but some areas on the inland side have scattered clumps of aspen, willows, and beach grasses.

The constant hazard of erosion and the sandy soil material very severely limit areas of this mapping unit for most uses other than recreation. Capability unit VIIIs-1; not in a woodland suitability group.

Lamson Series

The Lamson series consists of nearly level, poorly drained soils on lake plains and in small depressions on till plains. These soils formed in stratified silt, very fine sand, and silt loam.

In a representative profile the surface layer is black fine sandy loam 9 inches thick. The subsurface layer is 3 inches of olive-gray fine sandy loam. The subsoil is very friable very fine sandy loam 6 inches thick. Its color ranges from olive gray in the upper 2 inches to light brownish gray in the lower 4 inches. In the lower part the subsoil is mottled with yellowish brown and olive. The underlying material, at a depth of 18 inches, consists of layers of very fine sand, silt, light silty clay loam, and silt loam. The colors are gray or olive gray mottled with olive, light olive brown, olive gray, dark gray, and olive brown.

Permeability is moderate. The available water capacity is moderate, and fertility is medium. Surface runoff is very slow.

The Lamson soils are moderately well suited to farming and poorly suited as woodland. They have severe limitations for many nonfarm uses.

Representative profile of Lamson fine sandy loam, in a cultivated field in SE¼NE¼SE¼ sec. 8, T. 4 N., R. 4 E.:

Ap—0 to 9 inches, black (10YR 2/1) fine sandy loam; moderate, fine, granular structure; friable; mildly alkaline; abrupt, wavy boundary.

A2g—9 to 12 inches, olive-gray (5Y 5/2) fine sandy loam; weak, thin, platy structure; friable; mildly alkaline; abrupt, wavy boundary.

B21g—12 to 14 inches, olive-gray (5Y 5/2) very fine sandy loam; common, medium, faint, light olive-gray (5Y 6/2) mottles; weak, thin, platy structure; very friable; mildly alkaline; abrupt, irregular boundary.

B22g—14 to 18 inches, light brownish-gray (10YR 6/2) very fine sandy loam; many, medium, distinct, yellowish-brown (10YR 5/8) and olive (5Y 5/3) mottles; moderate, thin, platy structure; very friable; mildly alkaline; abrupt, wavy boundary.

C1g—18 to 25 inches, gray (5Y 5/1) silt; many, medium, distinct, olive-brown (2.5Y 4/4) and yellowish-brown (10YR 5/6) mottles; massive; firm; mildly alkaline, slightly effervescent; clear, wavy boundary.

C2g—25 to 38 inches, gray (5Y 5/1), stratified very fine sand and silt loam; many, medium, distinct, olive (5Y 5/3) and light olive-brown (2.5Y 5/4) mottles; massive; very friable; mildly alkaline, slightly effervescent; abrupt, wavy boundary.

IIC3g—38 to 46 inches, olive-gray (5Y 5/2) light silty clay loam; common, fine, distinct, olive-brown (2.5Y 4/4) and light olive-brown (2.5Y 5/6) mottles; massive; firm; mildly alkaline, slightly effervescent; abrupt, wavy boundary.

IIC4g—46 to 52 inches, olive-gray (5Y 4/2) light silty clay loam; many, medium, faint, olive-gray (5Y 5/2), dark-gray (5Y 4/1), and olive (5Y 4/3) mottles; massive; firm; mildly alkaline, slightly effervescent; clear, wavy boundary.

IIIC5—52 to 60 inches, gray (5Y 5/1) heavy silt loam; common, medium, prominent, olive-brown (2.5Y 4/4) mottles; massive; firm; mildly alkaline, slightly effervescent.

The Ap horizon ranges from 8 to 10 inches in thickness. The B horizon ranges from silt to fine sand. The layers of fine sand are less than 3 inches thick. The C horizon is fine sandy loam, fine sand, very fine sandy loam, very fine sand, silt, silty clay loam, or silt loam. It is mildly or moderately alkaline and slightly or strongly effervescent.

In Livingston County, these soils have a finer textured C horizon and a dominantly grayer B horizon than has been defined as the range for the series. These differences seem not to alter the usefulness and behavior of the soils.

Lamson soils are in the landscape adjacent to Arkport and Minoa soils. They are similar to Colwood soils. Lamson soils have a darker colored Ap horizon and are more poorly drained than the well-drained Arkport soils and the somewhat poorly drained Minoa soils. They have a coarser textured B horizon than Colwood soils.

Lamson fine sandy loam (0 to 2 percent slopes) (Lc).—This soil occupies irregularly shaped areas on lake plains and in depressions on till plains.

Included in mapping are small areas of somewhat poorly drained Minoa soils that are in slightly higher parts of areas mapped as this Lamson soil.

Surface runoff is very slow, permeability is moderate, and the erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

If adequately drained, this soil is moderately well suited to most crops commonly grown in the county. It is poorly suited as woodland. Capability unit IIIw-5 (3c); woodland suitability group 4w3.

Linwood Series

The Linwood series consists of nearly level, very poorly drained soils on lake plains, on till plains, and in depressional areas on moraines. These soils formed in 12 to 40 inches of organic deposits underlain by stratified silt loam, fine sandy loam, and very fine sand.

In a representative profile the surface layer is black muck 12 inches thick. The second layer is dark-brown, friable muck 9 inches thick. The third layer is dark reddish-brown, friable muck 9 inches thick. The fourth layer is olive-gray sedimentary peat 1 inch thick. The underlying material, at a depth of 31 inches, is light olive-gray, stratified silt loam, fine sandy loam, and very fine sand.

Permeability is moderately rapid in the organic layers and moderately slow in the underlying mineral material. The available water capacity is very high, and fertility is low. Surface runoff is very slow to ponded.

If adequately drained, these soils are well suited to farming, particularly to row crops. They are poorly suited as woodland. They have severe limitations for most nonfarm uses.

Representative profile of Linwood muck, in a wooded area in SW¼NE¼ sec. 21, T. 4 N., R. 3 E.:

1—0 to 12 inches, black (10YR 2/1) muck; weak, fine, granular structure; friable; common woody fragments; neutral.

2—12 to 21 inches, dark-brown (7.5YR 3/2) muck; moderate, fine, granular structure; friable; common root fragments; slightly acid.

3—21 to 30 inches, dark reddish-brown (5YR 3/2) muck; weak, fine, granular structure; friable; slightly acid.

4—30 to 31 inches, olive-gray (5Y 5/2) sedimentary peat; collodial, gelatinous; neutral.

IICg—31 to 60 inches, light olive-gray (5Y 6/2), stratified silt loam, fine sandy loam, and very fine sand; massive; friable; mildly alkaline, slightly effervescent.

The organic material generally is 25 to 40 inches thick, but it ranges from 12 to 40 inches in thickness over dominantly loamy material. A few profiles have organic subhorizons that have one or all of the following: less than 10 inches of mucky peat, less than 5 inches of peat, or less than 2 inches of sedimentary peat. Reaction throughout the organic material ranges from medium acid to neutral. The first horizon is black (10YR 2/1) or dark grayish brown (10YR 4/2). The IICg horizon is loam, silt loam, fine sandy loam, very fine sand, or light clay loam. The C horizon ranges from neutral to moderately alkaline.

Linwood soils are similar to Carlisle, Houghton, Edwards, and Tawas soils. Linwood soils have thinner organic material than Carlisle and Houghton soils, which have more than 42 inches of organic material. They lack the marl that is in the profile of Edwards soils. They have a finer textured C horizon than Tawas soils.

Linwood muck (0 to 2 percent slopes) (Lm).—This soil is in depressional areas on lake plains, till plains, and moraines. The areas range from 2 to 200 acres in size.

Included with this soil in mapping are small areas of the deeper Carlisle soils and of Tawas soils. The Tawas soils are underlain by sand and loamy sand. Included also are areas that contain strata of mineral soil material within a depth of 40 inches.

Surface runoff is slow to ponded. Permeability is moderately rapid in the organic layers and moderately slow in the underlying mineral material. The erosion hazard is moderate. The principal concerns of management on this soil are maintaining adequate drainage, control of soil blowing, and maintaining fertility.

Most of this soil is idle or in woodland, but a small acreage is still cultivated. If adequately drained and protected from soil blowing, this soil is well suited to most kinds of row crops and to hay. It is poorly suited to grain crops and as woodland. Capability unit IIw-10 (M/3c); woodland suitability group -w1.

Locke Series

The Locke series consists of nearly level or gently sloping, somewhat poorly drained soils on till plains and moraines. These soils formed in sandy loam till.

In a representative profile the surface layer is very dark gray sandy loam 9 inches thick. The subsurface layer is dark-gray sandy loam 4 inches thick. The upper part of the subsoil is strong-brown, friable sandy loam that is mottled with yellowish brown and brown and is 3 inches thick. The middle part is dark-brown and strong-brown, firm sandy clay loam that is mottled with grayish brown and yellowish brown and is 10 inches thick. The lower part is dark-brown, friable light sandy loam mottled with grayish brown and dark brown. It is 3 inches thick. The underlying material, at a depth of 29 inches. is brown sandy loam.

Permeability is moderate. The available water capacity is moderate, and fertility is medium. Surface runoff is slow.

The Locke soils are well suited to farming and moderately well suited as woodland. They have moderate or severe limitations for most nonfarm uses.

Representative profile of Locke sandy loam, 0 to 4 percent slopes, in a cultivated field in SW¼NE¼ sec. 22, T. 4 N., R. 3 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) sandy loam; weak, medium, granular structure; friable; 10 percent coarse fragments; neutral; clear, wavy boundary.

A2—9 to 13 inches, dark-gray (10YR 4/1) sandy loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles and common, fine, faint, grayish-brown (10YR 5/2) mottles; weak, thin, platy structure; very friable; 10 percent coarse fragments; neutral; clear, wavy boundary.

B1—13 to 16 inches, strong-brown (7.5YR 5/6) sandy loam; common, fine, faint, yellowish-brown (10YR 5/6) mottles and common, fine, distinct, brown (10YR 5/3) mottles; weak, fine, subangular blocky structure; friable; 10 percent coarse fragments; neutral; clear, wavy boundary.

B21t—16 to 26 inches, strong-brown (7.5YR 5/6) sandy clay loam; common, fine, distinct, grayish-brown (10YR 5/2) mottles and common, fine, faint, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm; dark reddish-brown (5YR 3/3) clay films on surface of peds; 10 percent coarse fragments; neutral; clear, wavy boundary.

B22tg—26 to 29 inches, dark-brown (7.5YR 4/2) light sandy loam; common, fine, faint, grayish-brown (10YR 5/2) and dark-brown (10YR 4/3) mottles; weak, medium, subangular blocky structure; friable; dark reddish-brown (5YR 3/3) clay films on surface of peds; 10 percent coarse fragments; neutral; abrupt, wavy boundary.

C—29 to 60 inches, brown (10YR 5/3) sandy loam; common, fine, faint, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; 10 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum generally is 24 to 36 inches but ranges from 20 to 40 inches. The reaction throughout the solum generally is slightly acid or neutral but ranges from medium acid to neutral. The B22tg horizon is sandy loam or sandy clay loam. In a few profiles the C horizon contains strata of loamy sand or loamy fine sand that are 1 to 5 inches thick. The C horizon is mildly or moderately alkaline and slightly or strongly effervescent.

Locke soils are in a drainage sequence with Hillsdale soils. They are similar to Conover and Metamora soils. Locke soils have a darker colored Ap horizon and are more poorly drained than Hillsdale soils; they have a coarser textured B horizon than Conover soils; and they lack the finer textured material that is in the C horizon of Metamora soils.

Locke sandy loam, 0 to 4 percent slopes (LoB).—This soil adjoins the higher lying Hillsdale soils on till plains and moraines. It is in areas that range from 2 to 40 acres in size.

Included with this soil in mapping, in the lower depressions, are small areas of the very poorly drained Barry soils. Small areas of the well-drained Hillsdale soils on the higher lying knolls are also included.

Surface runoff is slow, permeability is moderate, and the erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

If adequately drained, this soil is well suited to the crops commonly grown in the county. It is moderately well suited as woodland. Capability unit IIw-6 (3b); woodland suitability group 3w1.

Made Land

Made land (Md) consists of areas where the original soil profile has been destroyed by mixing or otherwise altered by land shaping. Made land is generally the result of cutting and filling for the development of building sites. Included are land fills over trash and refuse and other forms of land fill for present and future urban development. Capability unit VIIIs-1; not in a woodland suitability group.

Metamora Series

The Metamora series consists of somewhat poorly drained, nearly level or gently sloping soils on till plains and moraines. These soils formed in sandy loam, 18 to 40 inches thick, and in the underlying clay loam material.

In a representative profile the surface layer is very dark gray sandy loam 9 inches thick. The subsurface layer is brown light sandy loam 8 inches thick. The upper part of the subsoil is dark grayish-brown, friable sandy loam that has dark-brown mottles and is 4 inches thick. The middle part is dark grayish-brown, firm sandy clay loam that has yellowish-brown and brown mottles and is 14 inches thick. The lower part is mottled grayish-brown, reddish-brown, and yellowish-brown, firm clay loam 5 inches thick. The underlying material, at a depth of 40 inches, is grayish-brown light clay loam that is mottled with yellowish brown.

Permeability is moderate in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. The available water capacity is moderate, and fertility is medium. Surface runoff is slow.

The Metamora soils are well suited to farming and moderately well suited as woodland. They have moderate or severe limitations for most nonfarm uses.

Representative profile of Metamora sandy loam, 0 to 4 percent slopes, in a cultivated field in SW¼NE¼SW¼ sec. 16, T. 3 N., R. 3 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) sandy loam; weak, fine, granular structure; friable; 10 percent coarse fragments; medium acid; abrupt, smooth boundary.

A2—9 to 17 inches, brown (10YR 5/3) light sandy loam; common, medium, faint, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; very friable; several dark-gray (10YR 4/1) root channels ⅛ to ¾ inch wide; 10 percent coarse fragments; slightly acid; clear, irregular boundary.

B21g—17 to 21 inches, dark grayish-brown (10YR 4/2) sandy loam; many, fine, distinct, brown (7.5YR 4/4) mottles; weak, medium, subangular blocky structure; friable; 10 percent coarse fragments; neutral; abrupt, wavy boundary.

B22tg—21 to 35 inches, dark grayish-brown (10YR 4/2) sandy clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles and common, fine, faint, brown (10YR 5/3) mottles; moderate, medium, subangular blocky structure; friable; clay films on surfaces of peds; 10 percent coarse fragments; mildly alkaline; abrupt, wavery boundary.

IIB23tg—35 to 40 inches, mottled grayish-brown (10YR 5/2), reddish-brown (5YR 5/3), and yellowish-brown (10YR

5/6) clay loam; moderate, medium, subangular blocky structure; friable; clay films on surfaces of peds; 10 percent coarse fragments; mildly alkaline, slightly effervescent; gradual, wavy boundary.

IICg—40 to 60 inches, grayish-brown (10YR 5/2) light clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; firm; 10 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum generally is 30 to 40 inches but ranges from 25 to 40 inches. The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The B21g horizon is lacking in a few profiles. The thickness of the B22tg horizon generally is 7 to 14 inches but ranges from 1 to 24 inches. The depth to the IIB23tg horizon ranges from 18 to 36 inches. The IIB23tg horizon generally is 4 to 8 inches thick but ranges from 3 to 12 inches in thickness. In a few profiles loamy sand or sand is between the B22tg and IIB23tg horizons. The C horizon is loam or light clay loam. It is mildly or moderately alkaline and slightly or strongly effervescent.

Metamora soils are in a drainage sequence with Metea and Breckenridge soils and are similar to Conover and Locke soils. They have a darker colored surface layer and are more poorly drained than Metea soils. They are better drained than Breckenridge soils. Metamora soils are coarser textured in the upper part of the solum than Conover soils and have a finer textured C horizon than Locke soils.

Metamora sandy loam, 0 to 4 percent slopes (MlB).—This soil is on till plains and moraines in areas of 2 to 10 acres.

Included with this soil in mapping are small areas in which the surface layer and the upper part of the subsoil are loamy sand. These areas are common where this Metamora soil is closely associated with Metea soils. Also included are small areas of finer textured Conover soils.

Surface runoff is slow. Permeability is moderate in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. The erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

If adequately drained, this soil is well suited to crops commonly grown in the county. It is moderately well suited as woodland. Capability unit IIw-8 (3/2b); woodland suitability group 3w1.

Metea Series

The Metea series consists of well-drained, nearly level to strongly sloping soils on till plains and moraines. These soils formed in loamy sand, 18 to 40 inches thick, and in the underlying loam or clay loam glacial material.

In a representative profile the surface layer is very dark grayish-brown loamy sand 8 inches thick. The subsurface layer is brown loamy sand 3 inches thick. The upper part of the subsoil is light yellowish-brown, loose light loamy sand 18 inches thick. The lower part is reddish-brown or dark-brown, firm clay loam 19 inches thick. The underlying material, at a depth of 48 inches, is dark-brown loam.

Permeability is rapid in the upper part of the subsoil and moderate in the lower part of the subsoil and in the underlying material. The available water capacity is moderate, and fertility is low. Surface runoff is slow.

Metea soils are moderately well suited to farming and as woodland. They have moderate limitations for many nonfarm uses.

Representative profile of Metea loamy sand, 2 to 6 percent slopes, in a cultivated field in SE¼SW¼SE¼ sec. 33, T. 4 N., R. 3 E.:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, fine, granular structure; very friable; 5 percent coarse fragments; slightly acid; abrupt smooth boundary.

A2—8 to 11 inches, brown (10YR 5/3) loamy sand; weak, thin, platy structure; friable; 5 percent coarse fragments; strongly acid; clear, wavy boundary.

B1—11 to 29 inches, light yellowish-brown (10YR 6/4) light loamy sand; single grain; loose; 5 percent coarse fragments; slightly acid; abrupt, wavy boundary.

IIB21t—29 to 42 inches, reddish-brown (5YR 4/4) clay loam; moderate, coarse, subangular blocky structure; firm; clay films on surface of peds; 5 percent coarse fragments; medium acid; gradual, wavy boundary.

IIB22t—42 to 48 inches, brown (7.5YR 4/4) clay loam; moderate, coarse, subangular blocky structure; firm; clay films on surface of peds; 5 percent coarse fragments; neutral; clear, wavy boundary.

IIC—48 to 60 inches, brown (7.5YR 4/4) loam; massive; firm; 5 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum is 26 to 50 inches. Reaction throughout the solum ranges from strongly acid to neutral The Ap horizon is dark brown (10YR 4/3), very dark grayish brown (10YR 3/2), or brown (10YR 5/3). In a few profiles the B1 horizon has ⅜- to ¾-inch, discontinuous bands of dark-brown (10YR 4/3) heavy loamy sand, sandy loam, or light sandy clay loam. It is mildly or moderately alkaline and slightly or strongly effervescent.

Metea soils are in a drainage sequence with Metamora and Breckenridge soils They are associated with Miami soils and are similar to Owosso soils. Metea soils have a lighter colored Ap horizon and are better drained than the somewhat poorly drained Metamora and poorly drained Breckenridge soils. They are coarser textured in the upper part of the solum that Miami and Owosso soils.

Metea loamy sand, 0 to 2 percent slopes (MnA).—This soil is in small areas on till plains and moraines.

Included with this soil in mapping are small areas that have slopes of 3 to 4 percent. Also included, in small, wet depressions, are areas of somewhat poorly drained Metamora soils. Other inclusions are small areas of a moderately well drained soil that is similar to this Metea soil but has gray mottles in the lower part of the subsoil. Where this Metea soil occurs near Miami soils, small areas of those soils are included.

Surface runoff is slow. Permeability is rapid in the upper sandy part and moderately slow in the lower loamy part. The erosion hazard is slight. The principal concerns of management are maintaining fertility and conserving moisture.

This soil is moderately well suited as cropland and woodland. Capability unit IIIs-3 (4/2a); woodland suitability group 3s5.

Metea loamy sand, 2 to 6 percent slopes (MnB).—This soil is on hilltops on moraines and till plains. The areas are small and narrow. This soil has the profile described as representative for the series.

Included with this soil in mapping are small areas of Spinks-Oakville loamy sands that lack underlying loamy material. Small areas of finer textured Owosso soils also are included.

Surface runoff is slow. Permeability is rapid in the upper sandy part and moderately slow in the lower loamy part. The erosion hazard is slight. The principal concerns of management are conserving moisture and erosion control.

Most of this soil is farmed. The soil is moderately well suited as cropland and woodland. Capability unit IIIs–4 (4/2a); woodland suitability group 3s5.

Metea loamy sand, 6 to 12 percent slopes (MnC).—This soil is in a few narrow areas on moraines and till plains.

Included with this soil in mapping, where slopes are steeper, are a few small areas that have a brown surface layer. Also included are small wet depressions in which there are somewhat poorly drained Metamora soils. These areas may delay cultivation in spring or after rain. Other inclusions are small areas of finer textured Miami soils.

Surface runoff is slow. Permeability is rapid in the upper sandy part and moderately slow in the lower loamy part. The erosion hazard is moderate. The principal concerns of management are erosion control and conserving moisture.

This soil is moderately well suited as cropland and woodland. Capability unit IIIe–9 (4/2a); woodland suitability group 3s5.

Miami Series

The Miami series consists of well-drained, nearly level to very steep soils on till plains and moraines. These soils formed in loam and light clay loam till. In Livingston County, Miami soils are mapped alone and in complexes with Hillsdale, Conover, and Owosso soils.

In a representative profile the surface layer is dark grayish-brown loam 9 inches thick (fig. 4). The subsurface layer is pale-brown loam 3 inches thick. The upper part of the subsoil is yellowish-brown, friable light clay loam 5 inches thick; the middle part is yellowish-brown, friable clay loam 10 inches thick; and the lower part is brown, friable clay loam 4 inches thick. The underlying material, at a depth of 31 inches, is brown loam.

Permeability is moderate, and the available water capacity and fertility are high. Surface runoff is slow to rapid.

The nearly level to gently sloping Miami soils are well suited to farming and as woodland. Where slopes are 12 percent or less, Miami soils have only slight or moderate limitations for most nonfarm uses.

Representaive profile of Miami loam, 2 to 6 percent slopes, in a cultivated field in SW¼SW¼SW¼ sec. 24, T. 4 N., R. 4 E.:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable; less than 5 percent coarse fragments; slightly acid; abrupt, smooth boundary.

A2—9 to 12 inches, pale-brown (10YR 6/3) loam; very weak, fine, subangular blocky structure; friable; less than 5 percent coarse fragments; neutral; clear, wavy boundary.

B&A—12 to 17 inches, interfingering and tonguing of yellowish-brown (10YR 5/4) light clay loam from the B21t horizon and pale-brown (10YR 6/3) heavy loam from the A2 horizon; films on surface of peds and along worm holes and root channels; weak, fine, subangular blocky structure; friable; less than 5 percent coarse fragments; neutral; clear, wavy boundary.

B22t—17 to 27 inches, yellowish-brown (10YR 5/6) clay loam; moderate, medium, subangular blocky structure; friable; dark-brown (10YR 4/3) clay films on surface of most peds; less than 5 percent coarse fragments; neutral; clear, wavy boundary.

B23t—27 to 31 inches, brown (10YR 5/3) clay loam; weak, fine, subangular blocky structure; friable; dark-brown (10YR 4/3) clay films on surface of a few peds; less than 5 percent coarse fragments; mildly alkaline; abrupt, wavy boundary.

C—31 to 60 inches, brown (10YR 5/3) loam; weak, thin, platy structure; friable; less than 5 percent coarse fragments; mildly alkaline; slightly effervescent.

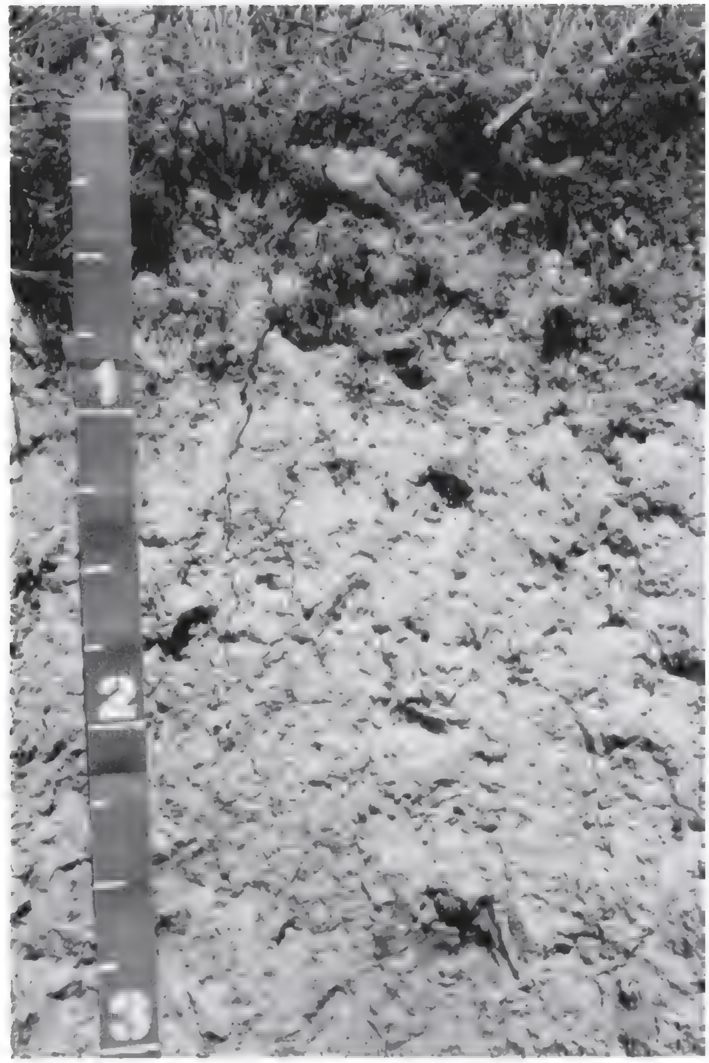


Figure 4.—**Profile of a well-drained Miami loam showing the subangular blocky structure in the subsoil. Numbers on tape indicate depth in feet.**

The thickness of the solum generally is 30 to 40 inches but ranges from 20 to 40 inches. The reaction throughout the solum is strongly acid to mildly alkaline. In a few soil profiles, there is an A1 horizon that is 1 to 5 inches thick and very dark gray (10YR 3/1) or dark gray (10YR 4/1). The thickness of the Ap horizon generally is 7 to 8 inches but ranges from 6 to 10 inches. The A2 horizon ranges from 0 to 11 inches in thickness and from pale brown (10YR 6/3) to yellowish brown (10YR 5/4) or brown (10YR 5/3) in color. The Bt horizon is dark yellowish brown (10YR 4/4), dark brown (7.5YR 4/4), yellowish brown (10YR 5/4 and 5/6), or brown (10YR 5/3). The C horizon is loam or light clay loam. It is mildly or moderately alkaline and slightly or strongly effervescent.

Miami soils are in a drainage sequence with Conover and Brookston soils. They are similar to Hillsdale, Metea, and Owosso soils. Miami soils are better drained than the somewhat poorly drained Conover soils and poorly drained Brooks-

ton soils. They have a finer textured B horizon than Hillsdale soils and are finer textured in the upper part of the B horizon than Metea and Owosso soils.

Miami loam, 0 to 2 percent slopes (MoA).—This soil is on till plains in areas of 2 to 10 acres.

Included with this soil in mapping, especially around Fowlerville, are areas underlain by sand and loamy sand at depths of 40 to 60 inches. Included at lower elevations are small areas of somewhat poorly drained Conover soils, and, on some of the knolls, coarser textured Metea and Owosso soils. Small depressions in which there are poorly drained Brookston soils and very poorly drained Linwood soils are also included, as well as small areas that are more sloping and a few small areas that have short slopes of more than 18 percent.

Surface runoff is slow, permeability is moderate, and the erosion hazard is slight. Management problems on this soil are slight.

This soil is well suited as cropland and woodland. Capability unit IIe-2 (2.5a); woodland suitability group 2o1.

Miami loam, 2 to 6 percent slopes (MoB).—This soil is on till plains and moraines. It has the profile described as representative for the series.

Included with this soil in mapping, in small depressions and in drainageways, are small wet areas of somewhat poorly drained Conover soils and poorly drained Brookston soils, and, in some of the depressions, very poorly drained Linwood soils. Also included, on small higher knolls, are small areas of coarser textured Owosso soils and Spinks-Oakville loamy sands. Small areas that have a dark yellowish-brown surface layer are included, as well as areas, especially around Fowlerville, that are underlain by sand or loamy sand at depths of 40 to 60 inches. Particularly in the northeastern part of the county, small areas in which the subsoil is finer textured than that described for the series are included. Other inclusions are small areas that are steeper. A few of these areas have slopes of more than 18 percent.

Surface runoff is slow, permeability is moderate, and the erosion hazard is slight. The principal concern of management is erosion control.

This soil is well suited as cropland and woodland. Capability unit IIe-2 (2.5a); woodland suitability group 2o1.

Miami loam, 6 to 12 percent slopes (MoC).—This soil is on till plains and moraines.

Included with this soil in mapping around Fowlerville, are areas where the underlying material, at depths of 40 to 60 inches, is sand or loamy sand. Small depressions and drainageways in which are small areas of the wetter, somewhat poorly drained Conover soils and poorly drained Brookston soils and small depressions in which are very poorly drained Carlisle soils are common inclusions. Also included are small areas that have a yellowish-brown or brown clay loam surface layer and a few small areas of the coarser textured Owosso soils and Spinks-Oakville loamy sands. Other inclusions are small areas in which the subsoil is finer textured than that described for the series and small areas that are more strongly sloping.

Surface runoff is medium, permeability is moderate, and the erosion hazard is moderate. The principal concern in management is control of erosion.

This soil is moderately well suited as cropland and well suited as woodland. Capability unit IIIe-5 (2.5a); woodland suitability group 2o1.

Miami loam, 12 to 18 percent slopes (MoD).—This soil is on moraines and till plains. In many areas the surface layer is dark yellowish brown or brown.

Included with this soil in mapping, around Fowlerville, are some areas where the underlying material, at depths of 40 to 60 inches, is sand or loamy sand. Also included are small depressions in which there are poorly drained, dark-colored Brookston soils or very poorly drained Carlisle soils and small areas that have slopes of more than 18 percent.

Surface runoff is rapid, permeability is moderate, and the erosion hazard is severe. The principal concern of management is control of erosion.

Only a small part of this soil is now cultivated. This soil is poorly suited to row crops, moderately well suited to grain crops, and well suited to forage crops and as woodland. Capability unit IVe-4 (2.5a); woodland suitability group 2o1.

Miami loam, 18 to 25 percent slopes (MoE).—This soil is on till plains and moraines. On the till plains it is adjacent to marshes, drainageways, and depressions.

Included with this soil in mapping are many small areas in which the surface layer is dark yellowish-brown or brown clay loam. These small areas are intermingled with areas in which the surface layer is dark grayish brown. Also included, around Fowlerville, are small areas in which the underlying material is sand or loamy sand at depths of 40 to 60 inches and, in the eastern part of the county, small areas of finer textured soils. Other inclusions are small depressional areas in which are wetter, poorly drained Washtenaw soils and very poorly drained Carlisle soils and small areas that are steeper.

Surface runoff is rapid, permeability is moderate, and the erosion hazard is severe. The principal concern of management is erosion control.

Most of this soil is now idle or in woodland. This soil is not suited as cropland. It is well suited as woodland, but it has moderate limitations because of slope. Capability unit VIe-2 (2.5a); woodland suitability group 2o2.

Miami loam, 25 to 35 percent slopes (MoF).—This soil is in hilly areas of moraines and till plains that adjoin marshes and valleys.

Included with this soil in mapping are small areas that have a surface layer of yellowish-brown or brown clay loam. In these areas the present surface layer is made up mainly of material from the original subsoil. Also included are small areas of coarse-textured Owosso soils and a few, small, wet depressions in which there are poorly drained Washtenaw soils and very poorly drained Carlisle soils.

Surface runoff is rapid, permeability is moderate, and the erosion hazard is severe. The principal concern of management is erosion control.

This soil is not suited to crops, because the erosion hazard is severe and slope limits the use of equipment. It is well suited as woodland, but it has moderate limitations caused by the steep slopes. Capability unit VIIe-2 (2.5a); woodland suitability group 2o2.

Miami-Conover loams, 2 to 6 percent slopes (MrB).—These soils are on till plains. They are in such small areas and are so intricately intermingled that it is not practical

to map them separately. The well-drained Miami soil is at slightly higher elevations than the somewhat poorly drained Conover soil.

Miami loam makes up about 55 to 65 percent of this complex, and Conover loam makes up about 35 to 45 percent.

Surface runoff is slow, permeability is moderate, and the erosion hazard is slight. The principal concerns of management are maintaining adequate drainage on the Conover soil and controlling erosion on the Miami soil.

These soils are well suited to crops. The Miami soil is well suited as woodland, and the Conover soil is moderately well suited. Capability unit IIe-2 (2.5a); woodland suitability groups 2o1 for Miami soil and 3w1 for Conover soil.

Minoa Series

The Minoa series consists of somewhat poorly drained, nearly level or gently sloping soils on lake plains and in small depressions on till plains. These soils formed in stratified silt, fine sand, and silt loam. In Livingston County, Minoa soils are mapped in a complex with Thetford soils.

In a representative profile the surface layer is very dark grayish-brown loamy fine sand 10 inches thick. The subsurface layer is brown fine sandy loam 4 inches thick. The subsoil is strong brown in the upper 10 inches and grades to yellowish brown in the lower 5 inches. It is friable fine sandy loam that is 15 inches thick and has grayish-brown mottles. The underlying material, at a depth of 29 inches, consists of layers of brown and yellowish-brown fine sand and silt loam. This material has yellowish-brown mottles.

Permeability is moderate. The available water capacity is moderate, and fertility is medium. Surface runoff is slow.

If the Minoa soils are adequately drained, they are moderately well suited to farming. They are moderately well suited as woodland, but they have severe limitations for most nonfarm uses.

Representative profile of Minoa loamy fine sand from an area of Minoa-Thetford complex, 0 to 4 percent slopes, in a cultivated field in SE¼SE¼SW¼ sec. 6, T. 1 N., R. 4 E.:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) loamy fine sand, light brownish gray (10YR 6/2) dry; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

A2—10 to 14 inches, brown (10YR 5/3) fine sandy loam; few, fine, faint, yellowish-brown (10YR 5/8) mottles; weak, thin, platy structure; friable; neutral; clear, wavy boundary.

B21—14 to 24 inches, strong-brown (7.5YR 5/6) fine sandy loam; common, coarse, distinct, grayish-brown (10YR 5/2) mottles; moderate, fine, subangular blocky structure; neutral; friable; clear, wavy boundary.

B22—24 to 29 inches, yellowish-brown (10YR 5/6) fine sandy loam; common, coarse, distinct, grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure; friable; neutral; clear, wavy boundary.

C1—29 to 36 inches, brown (10YR 5/3) silt loam and fine sand; ⅛- to 1/16-inch bands; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, thin, platy structure; friable; mildly alkaline, slightly effervescent; clear, wavy boundary.

C2—36 to 39 inches, brown (10YR 5/3) silt loam; common, coarse, faint, light brownish-gray (10YR 6/2) mottles; weak, thin, platy structure; firm; mildly alkaline, slightly effervescent; abrupt, smooth boundary.

C3—39 to 42 inches, yellowish-brown (10YR 5/6) fine sand and brown (10YR 5/3) silt loam, the fine sand and silt loam are in alternating ⅛- to 1/16-inch bands; massive (structureless) separating to weak, thin, platy structure; friable; calcium accumulations along root channels and worm holes and between fine sand and silt loam layers; mildly alkaline, slightly effervescent; clear, wavy boundary.

C4—42 to 60 inches, yellowish-brown (10YR 5/4) fine sand; massive; very friable; calcium accumulations along root channels and worm holes; mildly alkaline, slightly effervescent.

The thickness of the solum is 26 to 40 inches. Reaction throughout the solum is medium acid to neutral. In a few profiles, thin strata of sandy clay loam, light clay loam, or light silty clay loam are throughout the soil. The A2 horizon, if present, is brown (10YR 5/3) or pale brown (10YR 6/3). The B horizon ranges from 18 to 24 inches in thickness. The C horizon is mildly or moderately alkaline and slightly or strongly effervescent.

In these soils the B and C horizons are brighter colored and effervescent material is closer to the soil surface than has been defined as the range for the series, but these differences seem not to alter the usefulness and behavior of the soils.

Minoa soils are in a drainage sequence with Arkport and Lamson soils. They are similar to Locke soils and are mapped in a complex with Thetford soils. Minoa soils are wetter than Arkport soils but are not so poorly drained as Lamson soils. They lack the coarse fragments that are throughout the profile of Locke soils, and they are dominantly finer textured than Thetford soils.

Minoa-Thetford complex, 0 to 4 percent slopes (MwB).—The soils in this complex are on lake plains and in depressions on till plains. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. Minoa loamy fine sand makes up about 55 to 65 percent of the complex, and Thetford loamy sand about 35 to 45 percent. This complex occurs in areas between the somewhat poorly drained Wasepi soils and the very poorly drained Gilford or poorly drained Colwood soils. It also is at the base of slopes in the upland areas of Miami and Metea soils.

Surface runoff is slow. Permeability is moderate in the Minoa soil and moderately rapid in the Thetford soil. The erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

These soils are moderately well suited as cropland and woodland. Capability unit IIIw-5 (3b, 4b); woodland suitability groups 3w1 for Minoa soil and 3w2 for Thetford soil.

Oakville Series

The Oakville series consists of well-drained, nearly level to very steep soils on outwash plains, till plains, and moraines. These soils formed in fine sand. The loamy substratum phase is underlain with loam at a depth ranging from 40 to 66 inches. In Livingston County, Oakville soils are mapped alone and in complexes with Spinks soils.

In a representative profile the surface layer is dark grayish-brown fine sand 6 inches thick. The upper part of the subsoil is yellowish-brown, very friable fine sand 6 inches thick. The lower part is light yellowish-brown, very friable fine sand 10 inches thick. The underlying material, at a depth of 22 inches, is very pale brown and yellowish-brown, loose fine sand.

Permeability is rapid. The available water capacity and fertility are low. Surface runoff is slow to medium.

Oakville soils are poorly suited to farming but are moderately well suited as woodland. Where slopes are 12 percent or less, these soils have only slight limitations for most nonfarm uses.

Representative profile of Oakville fine sand, 0 to 6 percent slopes, in an idle area in NE¼SE¼SE¼ sec. 25, T. 1 N., R. 4 E.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) fine sand; weak, fine, granular structure; very friable; neutral; abrupt, smooth boundary.

B1—6 to 12 inches, yellowish-brown (10YR 5/6) fine sand; very weak, fine, subangular blocky structure; very friable; slightly acid; gradual, wavy boundary.

B21—12 to 22 inches, light yellowish-brown (10YR 6/4) fine sand; very weak, fine, subangular blocky structure; very friable; medium acid; clear, wavy boundary.

C1—22 to 44 inches, very pale brown (10YR 7/3) fine sand; single grain; loose; slightly acid; gradual, wavy boundary.

C2—44 to 54 inches, very pale brown (10YR 7/4) fine sand; single grain; loose; slightly acid; diffuse, wavy boundary.

C3—54 to 60 inches, yellowish-brown (10YR 5/8) fine sand; single grain; loose; slightly acid.

The reaction throughout the solum ranges from medium acid to neutral. In a few profiles color bands are in the B and C horizons. These bands are less than one-eighth inch thick and are yellowish brown (10YR 5/4) or dark yellowish brown (10YR 4/4). The B3 horizon, if present, is fine sand. The C horizon is fine sand, although it averages a higher content of coarser sand than the solum.

Oakville soils are associated with Ottokee soils and are mapped in complexes with Spinks soils. They are better drained than Ottokee soils. Also, they lack the mottles and textural bands that are in the solum of Ottokee soils. Oakville soils lack the textural bands that are in the solum of Spinks soils.

Oakville fine sand, 0 to 6 percent slopes (OaB).—This soil is on low moraines, till plains, and outwash plains. It has the profile described as representative for the series.

Included with this soil in mapping are small, shallow blowouts caused by soil blowing. Small depressions in which there are somewhat poorly drained Thetford soils are included, as are a few small areas that have slopes greater than 6 percent.

Surface runoff is slow, permeability is rapid, and the erosion hazard is moderate. The principal concerns of management are conserving moisture, maintaining fertility, and controlling soil blowing.

This soil is poorly suited as cropland but is moderately well suited as woodland. Capability unit IVs-4 (5a); woodland suitability group 3s5.

Oakville fine sand, loamy substratum, 0 to 6 percent slopes (OkB).—This soil is on low moraines, till plains, and outwash plains. Its areas range from 2 to 20 acres in size. The upper part of this soil contains less fine sand than the profile described as representative for the series. The lower part is underlain with loamy material at a depth of 40 to 66 inches.

Small, isolated depressions in which there are somewhat poorly drained Thetford soils and very poorly drained Tawas soils are included in the mapping. A few small areas that have slopes greater than 6 percent are included.

Surface runoff is slow. Permeability is rapid in the sandy material and moderate in the loamy underlying material. The erosion hazard is moderate. The principal concerns of management are conserving moisture, maintaining fertility, and control of soil blowing.

This soil is poorly suited as cropland but is moderately well suited as woodland. Capability unit IVs-4 (5/2a); woodland suitability group 3s5.

Oshtemo Series

The Oshtemo series consists of well-drained, nearly level to very steep soils on outwash plains, moraines, and valley trains. These soils formed in loamy sand. In Livingston County, Oshtemo soils are mapped in complexes with Boyer soils.

In a representative profile the surface layer is dark grayish-brown loamy sand 10 inches thick. The subsurface layer is brown sand 20 inches thick. The upper part of the subsoil is yellowish-brown, friable loamy sand 9 inches thick. The middle part is brown, friable sandy loam 6 inches thick. The lower part is brown, friable sandy clay loam 5 inches thick. The underlying material, at a depth of 50 inches, is yellowish-brown gravelly sand.

Permeability is moderate. The available water capacity and fertility are low. Surface runoff is slow to rapid.

Oshtemo soils are moderately well suited to farming and as woodland. Where slopes are 12 percent or less, the soils have only slight limitations for most nonfarm uses.

Representative profile of Oshtemo loamy sand from an area of Boyer-Oshtemo loamy sands, 2 to 6 percent slopes, in a cultivated area in NW¼NW¼NW¼ sec. 19, T. 4 N., R. 4 E.:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, fine, granular structure; friable; less than 10 percent coarse fragments; neutral; abrupt, smooth boundary.

A2—10 to 30 inches, brown (10YR 5/3) sand; single grain; loose; less than 10 percent coarse fragments; slightly acid; clear, wavy boundary.

B1—30 to 39 inches, yellowish-brown (10YR 5/4) loamy sand; weak, fine, granular structure; friable; less than 10 percent coarse fragments; slightly acid; clear, wavy boundary.

B21t—39 to 45 inches, brown (7.5YR 4/4) sandy loam; weak, fine, subangular blocky structure; friable; clay bridges connect sand grains; less than 10 percent coarse fragments; slightly acid; clear, wavy boundary.

B22t—45 to 50 inches, brown (7.5YR 4/4) sandy clay loam; massive; friable; clay bridges connect sand grains; 10 percent coarse fragments; slightly acid; abrupt, irregular boundary.

IIC—50 to 60 inches, yellowish-brown (10YR 5/4) gravelly sand; single grain; loose; 20 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum is 44 to 66 inches. The reaction throughout the solum ranges from medium acid to neutral. The Ap horizon is dark grayish brown (10YR 4/2), dark brown (10YR 4/3), or dark yellowish brown (10YR 4/2). The B22t horizon is sandy loam or sandy clay loam. It is brown (7.5YR 4/4), reddish brown (5YR 4/4), or dark yellowish brown (10YR 4/4). If the B22t horizon is sandy clay loam, it is less than 10 inches thick. In a few profiles a dark-brown (7.5YR 4/4) or dark yellowish-brown (10YR 5/4) B23 horizon is present. In many profiles, tongues of the B22t horizon extend into the C1 and IIC2 horizons to depths ranging from a few inches to several feet. The C horizon is mildly or moderately alkaline and slightly or strongly effervescent.

In Livingston County, these soils are coarser textured in the upper subhorizons than is defined as the range for the series. This difference alters their usefulness and behavior for many farm and nonfarm uses.

Oshtemo soils are in a drainage sequence with Bronson, Brady, and Gilford soils. They are similar to Fox and Boyer soils. Oshtemo soils are better drained than the moderately well drained Bronson, the somewhat poorly drained Brady, and the very poorly drained Gilford soils. They have a dominantly coarser textured B horizon and a thicker solum than Fox soils. Oshtemo soils have a thicker solum and are deeper to effervescent material than Boyer soils.

Ottokee Series

The Ottokee series consists of moderately well drained, nearly level or gently sloping soils on outwash plains. These soils formed in sand.

In a representative profile the surface layer is dark grayish-brown loamy sand 9 inches thick. The subsurface layer is yellowish-brown loamy sand 8 inches thick. The upper part of the subsoil is 14 inches of pale-brown loamy sand and thin bands of strong-brown loamy sand. The lower 18 inches consists of alternating layers of pale-brown fine sand and brown and strong-brown sandy loam. The entire subsoil is friable. The underlying material, at a depth of 49 inches, is very pale brown sand.

Permeability is rapid. The available water capacity and fertility are low. Surface runoff is slow.

The Ottokee soils are moderately well suited to farming and as woodland. They have moderate limitations for many nonfarm uses.

Representative profile of Ottokee loamy sand, 2 to 6 percent slopes, in a cultivated field in SW¼SW¼ sec. 11, T. 4 N., R. 3 E.:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.

A2—9 to 17 inches, yellowish-brown (10YR 5/4) loamy sand; massive; very friable; few, thin, discontinuous bands of brown (7.5YR 4/4) heavy loamy sand; neutral; abrupt, wavy boundary.

A&B1—17 to 31 inches, pale-brown (10YR 6/3) loamy sand; massive; very friable (A2); bands of strong-brown (7.5YR 5/6) loamy sand; massive; friable; clay bridges connect sand grains; bands are thin (Bt); neutral; abrupt, wavy boundary.

A&B2—31 to 49 inches, pale-brown (10YR 6/3) fine sand; common, fine, faint, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4) mottles; single grain; loose (A2); bands of brown (7.5YR 4/4) and strong-brown (7.5YR 5/6) sandy loam; common, fine, distinct, grayish-brown (10YR 5/2) mottles and common, fine, faint, yellowish-brown (10YR 5/4) mottles; massive; friable; clay bridges connect sand grains; bands are 1 to 3 inches thick and are spaced more than 3 inches apart (Bt); neutral; clear, wavy boundary.

C—49 to 60 inches, very pale brown (10YR 7/4) sand; single grain; loose; neutral.

The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). In a few profiles the depth to the first Bt band is more than 30 inches. The Bt bands are sandy loam or loamy sand.

Ottokee soils are similar to Spinks and Oakville soils. They have mottles that are lacking in the solum of Spinks soils, and they have mottles and textural bands that are lacking in the solum of Oakville soils.

Ottokee loamy sand, 0 to 2 percent slopes (OlA).—This soil is in small areas on outwash plains.

Included with this soil in mapping are small areas that have slopes of 3 or 4 percent. Also included are small, slightly higher areas of Spinks-Oakville loamy sands.

Surface runoff is slow, permeability is rapid, and the erosion hazard is moderate. The principal concerns of management are conserving moisture and controlling soil blowing.

This soil is moderately well suited as cropland and woodland. Capability unit IIIs-3 (5a); woodland suitability group 3s5.

Ottokee loamy sand, 2 to 6 percent slopes (OlB).—This soil is in small areas on outwash plains. It has the profile described as representative for the series.

Included with this soil in mapping are small areas that have slopes of less than 2 percent. Also included are a few small, steeper areas of well-drained Spinks-Oakville loamy sands.

Surface runoff is slow, permeability is rapid, and the erosion hazard is moderate. The principal concerns of management are conserving moisture and controlling soil blowing.

This soil is moderately well suited as cropland and woodland. Capability unit IIIs-4 (5a); woodland suitability group 3s5.

Owosso Series

The Owosso series consists of nearly level to hilly, well-drained soils on till plains and moraines. These soils formed in 18 to 40 inches of sandy loam and in the underlying loam or clay loam. In Livingston County, Owosso soils are mapped in complexes with Miami soils.

In a representative profile the surface layer is dark grayish-brown sandy loam 8 inches thick. The subsurface layer is pale-brown sandy loam 7 inches thick. The upper part of the subsoil is yellowish-brown, very friable light sandy loam 19 inches thick. The middle part is dark yellowish-brown, firm sandy clay loam 2 inches thick. The lower part is yellowish-brown, very firm clay loam 7 inches thick. The underlying material, at a depth of 43 inches, is brown loam.

Permeability is moderately rapid in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. The available water capacity is moderate, and fertility is medium. Surface runoff is slow to rapid.

The nearly level to gently sloping Owosso soils are well suited to farming and as woodland. Where slopes are 12 percent or less, these soils have only slight or moderate limitations for many nonfarm uses.

Representative profile of Owosso sandy loam from an area of Owosso-Miami sandy loams, 2 to 6 percent slopes, in a cultivated field in NW¼SW¼ sec. 33, T. 4 N., R. 3 E.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; less than 10 percent coarse fragments; neutral; abrupt, smooth boundary.

A2—8 to 15 inches, pale-brown (10YR 6/3) sandy loam; weak, coarse, granular structure; friable; less than 10 percent coarse fragments; slightly acid; clear, wavy boundary.

B21—15 to 34 inches, yellowish-brown (10YR 5/4) light sandy loam; weak, fine, subangular blocky structure; very friable; less than 10 percent coarse fragments; slightly acid; abrupt, wavy boundary.

B22t—34 to 36 inches, dark yellowish-brown (10YR 4/4) sandy clay loam; weak, medium, subangular blocky structure; firm; clay bridges connect sand grains; less than 10 percent coarse fragments; slightly acid; abrupt, wavy boundary.

IIB23t—36 to 43 inches, yellowish-brown (10YR 5/4) clay loam; moderate, medium, subangular blocky structure; firm; clay films on surface of peds; neutral; clear, wavy boundary.

IIC—43 to 60 inches, brown (10YR 5/3) loam; massive; firm; less than 10 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum generally is 30 to 40 inches but ranges from 28 to 54 inches. The solum is dominantly medium acid or slightly acid, but the Ap and IIB23t horizons range to neutral. The Ap horizon is dark brown (10YR 4/3) or dark grayish brown (10YR 4/2). The A2 horizon has weak, coarse, granular structure or weak, fine, platy structure. The B21 horizon is sandy loam or loamy sand. The B22t horizon is sandy loam or sandy clay loam. The depth to the IIB23t horizon generally is 24 to 38 inches but ranges from 18 to 40 inches. The IIB23t horizon is silty loam or clay loam. The IIC horizon is light clay loam or loam. It is mildly or moderately alkaline and slightly or strongly effervescent.

Owosso soils are similar to Metea soils and are mapped in complexes with Miami soils. Owosso soils are finer textured in the upper part of the solum than Metea soils and are coarser textured in the upper part of the solum than Miami soils.

Owosso-Miami sandy loams, 0 to 2 percent slopes (OmA).—These soils are on till plains and low moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. Each soil makes up about 35 to 55 percent of the complex. The profile of the Miami soil is similar to that described as representative for the series, except that it has a sandy loam surface layer.

Included with this complex in mapping are a few depressions and low-lying areas of somewhat poorly drained Metamora or Conover soils. Small, gently sloping areas are also included.

Surface runoff is slow. Permeability of the Owosso soil is moderately rapid in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. Permeability is moderate in the Miami soil. The erosion hazard is slight. Management concerns are few on these soils.

These soils are well suited as cropland and woodland. Capability unit IIs–2 (2.5a, 3/2a); woodland suitability group 2o1.

Owosso-Miami sandy loams, 2 to 6 percent slopes (OmB).—These soils are on till plains and low moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. The Owosso soil makes up about 50 percent of the complex, and the Miami soil about 35 to 40 percent. The profile of the Miami soil is similar to that described as representative for the series, except that it has a sandy loam surface layer.

Included with this soil in mapping, in drainageways and slight depressions, are small areas of somewhat poorly drained Metamora and Conover soils. Also included are a few small areas that have slopes greater than 6 percent.

Surface runoff is slow. Permeability of the Owosso soil is moderately rapid in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. Permeability is moderate in the Miami soil. The erosion hazard is slight. The principal concern of management on these soils is erosion control.

These soils are well suited as cropland and woodland. Capability unit IIe–3 (2.5a, 3/2a); woodland suitability group 2o1.

Owosso-Miami sandy loams, 6 to 12 percent slopes (OmC).—These soils are on till plains and low moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. The Owosso soil makes up about 50 percent of the complex, and the Miami soil about 35 to 40 percent. The Miami soil has a profile similar to that described as representative for the series, except that the surface layer is sandy loam.

Included with this complex in mapping are a few, isolated, small areas in which the surface layer is dark yellowish brown or dark brown. Also included, along drainageways and in depressions, are small areas of somewhat poorly drained Metamora and Conover soils.

Surface runoff is medium. Permeability of the Owosso soil is moderately rapid in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. Permeability is moderate in the Miami soil. The erosion hazard is moderate. The principal concern of management is erosion control.

These soils are moderately well suited as cropland and well suited as woodland. Capability unit IIIe–6 (2.5a, 3/2a); woodland suitability group 2o1.

Owosso-Miami sandy loams, 12 to 18 percent slopes (OmD).—These soils are on till plains and moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. The Owosso soil makes up about 50 percent of the complex, and the Miami soil about 35 to 40 percent. The Miami soil has a profile similar to that described as representative for the series, except that it has a sandy loam surface layer.

Included with these soils in mapping are a few small areas in which the surface layer is dark yellowish brown or dark brown. Also included in depressed areas are small areas of somewhat poorly drained Metamora and Conover soils or poorly drained Brookston soils. All of these soils are wetter than the Miami and Owosso soils.

Surface runoff is medium. Permeability of the Owosso soil is moderately rapid in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. Permeability is moderate in the Miami soil. The erosion hazard is severe. The principal concern of management is erosion control.

These soils are poorly suited to row crops. They are moderately well suited to grain crops and are well suited to forage crops and as woodland. Capability unit IVe–4 (2.5a, 3/2a); woodland suitability group 2o1.

Pewamo Series

The Pewamo series consists of poorly drained, nearly level soils on till plains. These soils formed in clay loam and silty clay loam till.

In a representative profile the surface layer is black clay loam 10 inches thick. The subsoil is gray, firm heavy silty clay loam that has dark-brown and yellowish-brown mottles and is 26 inches thick. The underlying material, at a depth of 36 inches, is dark-gray silty clay loam that has dark yellowish-brown mottles.

Permeability is moderately slow. The available water capacity and fertility are high. Surface runoff is slow to ponded.

If adequately drained, the Pewamo soils are well suited to farming, particularly to row crops. They are moderately well suited as woodland. They have severe limitations for many nonfarm uses.

Representative profile of Pewamo clay loam, in a cultivated field in SW¼NE¼ sec. 25, T. 4 N., R. 5 E.:

Ap—0 to 10 inches, black (10YR 2/1) clay loam; moderate, medium, granular structure; friable; less than 5 percent coarse fragments; mildly alkaline; abrupt, smooth boundary.

B2tg—10 to 36 inches, gray (5Y 5/1) heavy silty clay loam; many, medium, distinct, dark-brown (10YR 3/3) and yellowish-brown (10YR 5/8) mottles; moderate, medium, angular blocky structure; firm; clay films on surface of peds; less than 5 percent coarse fragments; mildly alkaline; clear, wavy boundary.

Cg—36 to 60 inches, dark-gray (5Y 4/1) silty clay loam; many, medium, prominent, dark yellowish-brown (10YR 4/4) mottles; massive; firm; less than 5 percent coarse fragments; moderately alkaline, slightly effervescent.

The thickness of the solum generally is 24 to 40 inches. Reaction throughout the solum ranges from slightly acid to mildly alkaline. The Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The C horizon is mildly or moderately alkaline and slightly or strongly effervescent.

Pewamo soils are associated with Conover soils and are similar to Brookston soils. Pewamo soils have a thicker and darker colored Ap horizon than somewhat poorly drained Conover soils. They generally have a finer textured B horizon than Brookston soils.

Pewamo clay loam (0 to 2 percent slopes) (Pc).—This soil is on till plains in areas of 2 to 50 acres. The smaller areas are in depressions or drainageways.

Included with this soil in mapping are small, slightly higher areas of somewhat poorly drained Conover soils and small areas of coarser textured Brookston soils. Small depressions in which there are very poorly drained Linwood and Carlisle soils are also included.

Surface runoff is slow to ponded, permeability is moderately slow, and the erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

If adequately drained, this soil is well suited to crops, particularly to row crops. It is moderately well suited as woodland. Capability unit IIw-2 (1.5c); woodland suitability group 3w3.

Rifle Series

The Rifle series consists of very poorly drained, nearly level soils. These soils occur in depressions on moraines and till plains and as wide strips in glacial drainageways and in slack water areas adjacent to lakes. They formed in deep organic material.

In a representative profile the surface layer is dark reddish-brown muck 13 inches thick. The second layer is black mucky peat 29 inches thick. The underlying material, at a depth of 42 inches, is dark-brown mucky peat.

Permeability is moderately rapid. The available water capacity is very high, and fertility is low. Surface runoff is slow to ponded.

If adequately drained and limed, the Rifle soils are moderately well suited to farming, particularly to row crops. They are poorly suited as woodland. They have severe limitations for most nonfarm uses.

Representative profile of Rifle muck, in a brushy area in SW¼NW¼ sec. 19, T. 1 N., R. 4 E.:

1—0 to 13 inches, dark, reddish-brown (5YR 2/2) muck; weak, coarse, subangular blocky structure; friable; many fibrous roots; derived primarily from reeds and sedges; common, partially decomposed woody fragments; extremely acid.

2—13 to 42 inches, black (10YR 2/1) mucky peat; massive; friable; derived primarily from reeds and sedges; very strongly acid.

3—42 to 60 inches, dark-brown (10YR 4/3) mucky peat; massive; friable; derived from sedge material; strongly acid.

The organic material is 42 inches or more thick. Content of woody fragments ranges from less than 1 to 20 percent, by volume, in the upper horizons. The lower horizons contain less than 1 to 5 percent woody fragments, by volume, but are dominantly the remains of fibrous plants. The reaction of horizons 1 and 2 ranges from extremely acid to strongly acid. The reaction of horizon 3 is strongly acid or medium acid.

In Livingston County, these soils have an annual temperature that is a few degrees warmer than is within the defined range for the series. They also are more acid in the upper part of the profile than is defined as the range for the series. These differences alter the usefulness and behavior of the soils for many farm and nonfarm uses.

Rifle soils are similar to Houghton and Carlisle soils. They are less decomposed in the subhorizons than those soils.

Rifle muck (0 to 2 percent slopes) (Rf).—This soil is in small depressional areas on moraines and till plains. It is also in wide strips in glacial drainageways and in slack water areas on lake plains adjacent to lakes and streams.

Surface runoff is slow to ponded, and permeability is moderately rapid. In drained areas the hazard of soil blowing is moderate. The principal concerns of management are maintaining adequate drainage and controlling soil blowing.

If adequately drained and limed, this soil is moderately well suited to crops, especially to row crops. It is poorly suited as woodland. Capability unit IIIw-15 (Mc); woodland suitability group -w1.

Sebewa Series

The Sebewa series consists of poorly drained, nearly level soils on outwash plains and valley trains. These soils formed in sandy loam material.

In a representative profile the surface layer is very dark gray loam 10 inches thick. The upper part of the subsoil is light-gray, very friable light sandy loam that has yellowish-brown mottles and is 11 inches thick. The lower part is light-gray, firm, sandy clay loam that has yellowish-brown mottles and is 12 inches thick. The underlying material, at a depth of 33 inches, is light-gray gravelly sand that has yellowish-brown mottles.

Permeability is moderate. The available water capacity is moderate, and fertility is high. Surface runoff is slow.

If adequately drained, Sebewa soils are well suited to farming, especially to row crops. They are moderately well suited as woodland. They have severe limitations for most nonfarm uses.

Representative profile of Sebewa loam, in a cultivated field in SW¼ sec. 28, T. 4 N., R. 3 E.:

Ap—0 to 10 inches, very dark gray (10YR 3/1) loam; moderate, medium, granular structure; friable; less

than 10 percent coarse fragments; neutral; abrupt, smooth boundary.

B21g—10 to 21 inches, light-gray (5Y 6/1) light sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles and common, fine, faint, gray (5Y 5/1) mottles; weak, fine, granular structure; very friable; less than 10 percent coarse fragments; neutral; abrupt, wavy boundary.

B22tg—21 to 33 inches, light-gray (5Y 6/1) sandy clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; clay bridges connect sand grains; 10 percent coarse fragments; neutral; abrupt, irregular boundary.

IICg—33 to 60 inches, light-gray (5Y 6/1) gravelly sand; common, fine, distinct, yellowish-brown (10YR 5/4) mottles; single grain; loose; 30 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum generally is 33 to 40 inches but ranges from 24 to 40 inches. The Ap horizon is black (10YR 2/1), very dark gray (10YR 3/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). The Btg horizon ranges from 10 to 26 inches in thickness. It is sandy clay loam, sandy loam, or clay loam. A B23 horizon, if present, is sandy loam, loam, sandy clay loam, or clay loam. In a few profiles the IICg horizon has strata of silt loam or fine sand in the upper part. It is mildly or moderately alkaline and slightly or strongly effervescent.

Sebewa soils are associated with Fox soils and are similar to Gilford, Barry, Colwood, and Berville soils. Sebewa soils are wetter and have a darker Ap horizon than Fox soils. They are dominantly finer textured in the B horizon than Gilford soils. They have a coarser textured C horizon than Barry, Colwood, and Berville soils.

Sebewa loam (0 to 2 percent slopes) (Se).—This soil is on outwash plains and valley trains in areas of 5 to 30 acres.

Included with this soil in mapping are small, slightly higher areas of coarser textured, somewhat poorly drained Brady soils and slightly lower areas of coarser textured, very poorly drained Gilford soils. A few slightly higher areas of a somewhat poorly drained soil that is similar in texture to this Sebewa soil also are included.

Surface runoff is slow, permeability is moderate, and the erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

If adequately drained, this soil is well suited to crops, especially to row crops. It is moderately well suited as woodland. Capability unit IIw-6 (3c); woodland suitability group 3w3.

Spinks Series

The Spinks series consists of well-drained, nearly level to very steep soils on till plains, outwash plains, and moraines. These soils occur mostly on moraines. They formed in deep sand. In Livingston County, Spinks soils are mapped in complexes with Oakville soils.

In a representative profile the surface layer is dark-brown loamy sand 9 inches thick. The subsurface layer is yellowish-brown light loamy sand 19 inches thick. The subsoil is 32 inches thick and is made up of alternating bands of very pale brown sand and brown heavy loamy sand. The bands of very pale brown sand range in thickness from 2 to 4 inches, whereas the bands of brown heavy loamy sand are 1/8 to 2 inches thick. The subsoil is loose and friable. The underlying material, at a depth of 60 inches, is light yellowish-brown sand.

Permeability is moderately rapid. The available water capacity and fertility are low. Surface runoff is slow to medium.

Spinks soils are poorly suited to farming but are moderately well suited as woodland. Where slopes are 12 percent or less, these soils have slight limitations for many nonfarm uses.

Representative profile of Spinks loamy sand from an area of Spinks-Oakville loamy sands, 0 to 6 percent slopes, in a cultivated field in SW1/4NW1/4 sec. 24, T. 1 N., R. 4 E.:

Ap—0 to 9 inches, dark-brown (10YR 4/3) loamy sand; weak, medium, granular structure; very friable; neutral; abrupt, smooth boundary.

A2—9 to 28 inches, yellowish-brown (10YR 5/4) light loamy sand; single grain; loose; neutral; abrupt, wavy boundary.

A&B—28 to 60 inches, very pale brown (10YR 7/4) sand (A2); single grain; loose; bands of brown (7.5YR 4/4) heavy loamy sand (Bt); weak, medium, subangular blocky structure; friable; clay bridges connect sand grains; bands are 1/8 to 2 inches thick and are spaced 2 to 4 inches apart; neutral; abrupt, wavy boundary.

C—60 to 66 inches, light yellowish-brown (10YR 6/4) sand; single grain; loose; neutral.

The reaction of the solum is slightly acid to neutral. The Ap horizon ranges from dark grayish brown (10YR 4/2) to dark yellowish brown (10YR 4/4). The depth to the first Bt band in the A&B horizon ranges from 25 to 38 inches. The Bt bands in the A&B horizon are loamy sand or light sandy loam. The C horizon is neutral or mildly alkaline. In a few profiles the C horizon is slightly or strongly effervescent.

Spinks soils are mapped in complexes with Oakville soils. They are similar to Arkport soils and are in a drainage sequence with Ottokee soils. Spinks soils have textural bands that are lacking in the solum of Oakville soils. They are dominantly coarser textured than Arkport soils and lack the mottles that are in the solum of Ottokee soils.

Spinks-Oakville loamy sands, 0 to 6 percent slopes (SvB).—These soils are on till plains, outwash plains, and moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. The Spinks soil makes up about 50 to 60 percent of the complex, and the Oakville soil about 25 to 35 percent.

Included with these soils in mapping are small areas of Metea soils where the complex occurs with Miami soils. The Metea soils are underlain by loam or clay loam at a depth of 18 to 40 inches. Also included are a few small areas that have loam underlying material between depths of 40 to 70 inches. Small areas of the finer textured Oshtemo soils also are included. Other inclusions are small depressions in which there are moderately well drained Ottokee soils and somewhat poorly drained Thetford soils, as well as small areas that have slopes greater than 6 percent.

Surface runoff is slow. Permeability is moderately rapid in the Spinks soil and is rapid in the Oakville soil. The erosion hazard is slight. The principal concerns of management are moisture conservation and controlling soil blowing.

These soils are moderately well suited as cropland and woodland. Capability unit IIIs-3 (4a, 5a); woodland suitability group 3s5.

Spinks-Oakville loamy sands, 6 to 12 percent slopes (SvC).—These soils are on moraines, outwash plains, and till plains. They are in such small areas and are so intricately intermingled that it is not practical to map them

separately. The Spinks soil makes up about 50 to 60 percent of the complex, and the Oakville soil about 25 to 35 percent.

Included with these soils in mapping are some areas that have a yellowish-brown surface layer and some areas that are smiliar to the Spinks soil but are more acid. Also included are small areas of finer textured Oshtemo and Hillsdale soils. In drainageways are included some small areas of somewhat poorly drained Thetford soils and very poorly drained Gilford soils. In areas where this mapping unit occurs with Miami soils, small areas of Metea soils are included. Also included are small areas that have slopes greater than 12 percent.

Surface runoff is slow. Permeability is moderately rapid in the Spinks soil and is rapid in the Oakville soil. The erosion hazard is moderate. The principal concerns of management on these soils are controlling erosion and conserving moisture.

These soils are used for cropland, pasture, and woodland. They are moderately well suited as cropland and woodland. Capability unit IIIe-9 (4a, 5a); woodland suitability group 3s5.

Spinks-Oakville loamy sands, 12 to 18 percent slopes (SvD).—These soils are on till plains, moraines, and outwash plains. They occur on side slopes on moraines and around potholes and basins on till plains. The larger areas of the complex are on moraines. The soils are in such small areas and are so intricately intermingled that it is not practical to map them separately. The Spinks soil makes up about 50 percent of the complex, and the Oakville soil about 25 to 35 percent.

Some areas included with these soils in mapping have a yellowish-brown surface layer. Where the complex occurs with Miami soils, small areas of Metea soils are included. The Metea soils are underlain with loam or clay loam at a depth of 18 to 40 inches. Small areas of the finer textured Oshtemo soils are included, as well as small depressions in which there are very poorly drained Gilford, Carlisle, and Tawas soils. Also included are small areas that have slopes greater than 18 percent.

Surface runoff is medium. Permeability is moderately rapid in the Spinks soil and is rapid in the Oakville soil. The erosion hazard is moderate. The principal concerns of management are erosion control and conserving moisture.

These soils are poorly suited as cropland. They are moderately well suited to forage crops and as woodland. Capability unit IVe-9 (4a, 5a); woodland suitability group 3s5.

Spinks-Oakville loamy sands, 18 to 25 percent slopes (SvE).—These soils are on till plains, outwash plains, and moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. The Spinks soil makes up about 50 percent of the complex, and the Oakville soil about 25 to 35 percent.

Included with these soils in mapping are small areas of finer textured Miami and Oshtemo soils and small areas that have a yellowish-brown surface layer.

Surface runoff is medium. Permeability is moderately rapid in the Spinks soil and is rapid in the Oakville soil. The erosion hazard is severe. The principal concern of management is erosion control.

These soils are not suited to crops. They are moderately well suited as woodland, but there are moderate limitations because of steep slopes. Capability unit VIe-2 (4a, 5a); woodland suitability group 3s6.

Spinks-Oakville loamy sands, 25 to 35 percent slopes (SvF).—These soils are on till plains and moraines. They are in such small areas and are so intricately intermingled that it is not practical to map them separately. Each soil makes up about 40 to 50 percent of the complex.

Included with these soils in mapping are small areas that have a yellowish-brown surface layer and small areas of the finer textured Oshtemo soils.

Surface runoff is medium. Permeability is moderately rapid in the Spinks soil and rapid in the Oakville soil. The erosion hazard is severe. The principal concern of management is erosion control .

These soils are not suited to crops. They are moderately well suited as woodland, but there are moderate limitations because of the steep slopes. Capability unit VIIe-2 (4a, 5a); woodland suitability group 3s6.

Tawas Series

The Tawas series consists of very poorly drained, nearly level soils. These soils occur in depressional areas on outwash plains, lake plains, till plains, and moraines. They formed in 12 to 40 inches of organic material underlain by sand and loamy sand.

In a representative profile the surface layer is black muck 18 inches thick. The underlying material is gray sand that contains yellowish-brown and light brownish-gray mottles.

Permeability is moderately rapid. The available water capacity is moderate, and fertility is low. Surface runoff is very slow to ponded.

Tawas soils are poorly suited to farming and as woodland. They have severe limitations for most nonfarm uses.

Representative profile of Tawas muck, in a wooded area in NW¼SW¼ sec. 6, T. 2 N., R. 5 E.:

1—0 to 18 inches, black (10YR 2/1) muck; moderate, medium granular structure; friable; contains well-decomposed fragments of woody and fibrous material; neutral.

IIC—18 to 60 inches, gray (10YR 6/1) sand; common, fine, distinct, yellowish-brown (10YR 5/6) mottles and common, fine, faint, light brownish-gray (10YR 6/2) mottles; single grain; loose; neutral in upper part and mildly alkaline in lower part.

The organic material is 12 to 40 inches thick over sandy materials. In a few profiles one or all of the following are between the muck and sandy materials: less than 2 inches of sedimentary peat, less than 10 inches of mucky peat, and less than 5 inches of peat. The kind and amount of identifiable woody and fibrous plants throughout the organic material are none to many. Reaction throughout the organic material ranges from medium acid to neutral. In a few profiles the C horizon is slightly or strongly effervescent.

In Livingston County, these soils have an annual temperature a few degrees warmer than is within the defined range for the series. This difference does not alter their usefulness and behavior for many farm and nonfarm uses.

Tawas soils are similar to Carlisle, Houghton, Linwood, and Edwards soils. They have thinner organic material than Carlisle and Houghton soils. They differ from Linwood and Edwards soils in having sandy material instead of loamy material or marl material, respectively, in the C horizon.

Tawas muck (0 to 2 percent slopes) (Tm).—This soil is in depressions on outwash plains, lake plains, till plains,

and moraines. Its areas range from 2 to 100 acres in size.

Included with this soil in mapping are small areas of Carlisle and Linwood soils. The Carlisle soil occurs in the center of some of the larger areas of Tawas soil.

Surface runoff is very slow to ponded, permeability is moderately rapid, and the erosion hazard is moderate. The principal concerns of management are maintaining adequate drainage and controlling soil blowing.

This soil is poorly suited as cropland and woodland. Capability unit IVw-5 (M/4c); woodland suitability group -w1.

Thetford Series

The Thetford series consists of somewhat poorly drained, nearly level or gently sloping soils on till plains and lake plains. These soils formed in very fine sand. In Livingston County, Thetford soils are mapped in a complex with Minoa soils.

In a representative profile the surface layer is very dark grayish-brown loamy sand 6 inches thick. The first part of the subsoil is dark-brown, friable loamy sand 6 inches thick. The second part is light yellowish-brown, friable loamy sand that has yellowish-brown and grayish-brown mottles and is 12 inches thick. The third part is very pale brown, loose loamy sand that has brownish-yellow and grayish-brown mottles and is 4 inches thick. The fourth part is a series of layers of loamy sand and light sandy loam. These layers have a total thickness of 22 inches. The layers of very pale brown, loose loamy sand have dark yellowish-brown mottles. The layers of yellowish-brown, friable light sandy loam are discontinuous and are ¼ to 1 inch thick. Below these layers is yellowish-brown, very friable heavy loamy sand that has brownish-yellow and light-gray mottles and is 5 inches thick. The underlying material, at a depth of 55 inches, is mottled light-gray, brown, and yellowish-brown very fine sand.

Permeability is moderately rapid. The available water capacity and fertility are low. Surface runoff is low.

These soils are poorly suited to farming. They are moderately well suited as woodland. They have moderate to severe limitations for many nonfarm uses.

Representative profile of Thetford loamy sand from an area of Minoa-Thetford complex, 0 to 4 percent slopes, in a cultivated area in NE¼SE¼ sec. 9, T. 4 N., R. 3 E.:

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2 loamy sand; weak, fine, granular structure; very friable; neutral; abrupt, smooth boundary.

B1—6 to 12 inches, dark-brown (10YR 4/3) loamy sand; few, fine, distinct, yellowish-brown (10YR 5/8) mottles in the lower part; weak, fine, granular structure; friable; slightly acid; clear, wavy boundary.

B2—12 to 24 inches, light yellowish-brown (10YR 6/4) loamy sand; common, fine, distinct, yellowish-brown (10YR 5/8) and grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure; friable; neutral; clear, wavy boundary.

A'21—24 to 28 inches, very pale brown (10YR 7/3) loamy sand; common, fine, distinct, brownish-yellow (10YR 6/6) and grayish-brown (10YR 5/2) mottles; single grain; loose; neutral; abrupt, wavy boundary.

A'&B'—28 to 50 inches, very pale brown (10YR 8/3) loamy sand (A'); common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; single grain; loose; bands of yellowish-brown (10YR 5/4) light sandy loam (Bt); weak, very fine and fine, subangular blocky structure; friable; clay bridges connect sand grains; bands are ¼ to 1 inch thick and discontinuous; neutral; clear, wavy boundary.

B'2t—50 to 55 inches, yellowish-brown (10YR 5/4) heavy loamy sand; common, fine, distinct, brownish-yellow (10YR 6/8) and light-gray (10YR 6/1) mottles; weak, fine, subangular blocky structure; very friable; neutral; clear, wavy boundary.

C—55 to 60 inches, mottled light-gray (10YR 6/1), brown (10YR 5/3), and yellowish-brown (10YR 5/8) very fine sand; single grain; loose; mildly alkaline.

The reaction throughout the solum, except for the B'2t horizon, is slightly acid or neutral. The B'2t horizon is neutral or mildly alkaline. The Ap horizon is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2). The depth to the first B't band in the A'&B' horizon ranges from 18 to 30 inches. The B't bands and the A'&B' horizon range from ¼ to 3 inches in thickness. The B'2t horizon is loamy sand or sandy loam. The C horizon ranges from sand to very fine sand.

Thetford soils are mapped in a complex with Minoa soils and are similar to Wasepi soils. Thetford soils have a dominantly coarser textured solum than Minoa and Wasepi soils.

Warners Series

The Warners series consists of very poorly drained, nearly level soils that are underlain with marl. These soils occur in depressional areas within flood plains and glacial drainageways and in slack water areas adjacent to lakes. They formed in 12 inches or less of loam material underlain by marl.

In a representative profile the surface layer is black loam 12 inches thick. The underlying material is gray marl that contains numerous shells.

Permeability is variable. The available water capacity is high, and fertility is low. Surface runoff is very slow to ponded.

Warners soils are poorly suited to farming and as woodland. They have severe limitations for most nonfarm uses.

Representative profile of Warners loam, in a pasture field in NE¼SW¼ sec. 28, T. 4 N., R. 6 E.:

Ap—0 to 12 inches, black (10YR 2/1) loam; moderate, fine, granular structure; friable; mildly alkaline.

IICg—12 to 40 inches, gray (10YR 6/1) marl; massive; friable; contains common shells and shell fragments; moderately alkaline, violently effervescent.

In many profiles the marl contains a high percentage of mineral material, but in others it is 80 to 90 percent calcium carbonate.

Warners soils are similar to Edwards soils. They are shallower to marl than Edwards soils.

Warners loam (0 to 2 percent slopes) (Wc).—This soil is in depressions on flood plains, lake plains, and glacial drainageways.

Included with this soil in mapping are small areas that have a muck surface layer. Also included are a few spots of exposed marl.

Surface runoff is very slow to ponded, permeability is variable, and the erosion hazard is moderate. The principal concerns of management are wetness, low fertility, and the generally poor physical and chemical properties of the underlying marl.

This soil is poorly suited as cropland and woodland. Capability unit IVw-6 (M/mc); woodland suitability group -w1.

Wasepi Series

The Wasepi series consists of somewhat poorly drained, nearly level soils on outwash plains and valley trains. These soils formed in loamy sands.

In a representative profile the surface layer is very dark gray sandy loam 9 inches thick. The subsurface layer is grayish-brown sandy loam that has yellowish-brown mottles and is 5 inches thick. The upper part of the subsoil is brown, firm sandy clay loam that has brownish-yellow mottles and is 5 inches thick. The middle part is brown, firm loam that has brownish-yellow and dark grayish-brown mottles and is 4 inches thick. The lower part is dark grayish-brown, friable loamy sand that has yellowish-brown mottles and is 4 inches thick. The underlying material, at a depth of 27 inches, is gray loamy sand grading to light-gray gravelly sand at a depth of 34 inches.

Permeability is moderately rapid. The available water capacity is low, and fertility is medium. Surface runoff is slow.

Wasepi soils are moderately well suited to farming and as woodland. They have moderate to severe limitations for many nonfarm uses.

Representative profile of Wasepi sandy loam, 0 to 2 percent slopes, in a cultivated field in NE¼SE¼ sec. 30, T. 1 N., R. 3 E.:

Ap—0 to 9 inches, very dark gray (10YR 3/1) sandy loam; weak, fine, granular structure; friable; less than 10 percent coarse fragments; neutral; abrupt, smooth boundary.

A2—9 to 14 inches, grayish-brown (10YR 5/2) sandy loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; friable; common dark-brown (10YR 3/3) worm holes; less than 10 percent coarse fragments; slightly acid; clear, wavy boundary.

B21t—14 to 19 inches, brown (10YR 5/3) sandy clay loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; moderate, medium, subangular blocky structure; firm; clay bridges connect sand grains; less than 10 percent coarse fragments; neutral; clear, wavy boundary.

B22t—19 to 23 inches, brown (10YR 5/3) loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles and common, fine, faint, dark grayish-brown (10YR 4/2) mottles; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; less than 10 percent coarse fragments; neutral; abrupt, irregular boundary.

B23g—23 to 27 inches, dark grayish-brown (10YR 4/2) loamy sand; common, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine, subangular blocky structure; friable; 10 percent coarse fragments; neutral; clear, wavy boundary.

IIC1g—27 to 34 inches, gray (10YR 5/1) loamy sand; single grain; loose; 10 percent coarse fragments; mildly alkaline; abrupt, wavy boundary.

IIC2g—34 to 60 inches, light-gray (10YR 7/1) gravelly sand; single grain; 30 percent coarse fragments; mildly alkaline, slightly effervescent.

The thickness of the solum generally is 21 to 40 inches. The Ap horizon ranges from 8 to 10 inches in thickness. The Ap horizon is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or very dark brown (10YR 2/2). The A2 horizon ranges from sand to sandy loam and is brown (10YR 5/3), yellowish brown (10YR 5/4), or grayish brown (10YR 5/2). The B21t and B22t horizons are sandy loam, loam, or sandy clay loam. The B21t horizon is brown (10YR 5/3), yellowish brown (10YR 5/4, 5/6, or 5/8), dark grayish brown (10YR 4/2), and dark gray (10YR 4/1). The B22t horizon is grayish brown (10YR 5/2), dark brown (10YR 4/3), pale brown (10YR 6/3), brown (10YR 5/3), and yellowish brown (10YR 5/6). The B23g horizon is loamy sand to sandy loam.

In Livingston County, the first subhorizon of these soils is less gray than is within the defined range for the series, but this difference seems not to alter the usefulness and behavior of the soils.

Wasepi soils are similar to Brady and Thetford soils. They have a thinner solum than Brady soils and a dominantly finer textured solum than Thetford soils.

Wasepi sandy loam, 0 to 2 percent slopes (WeA).—This soil is in long narrow strips surrounded by steeper, better drained soils on outwash plains and valley trains. A few areas have a loamy sand surface layer.

Included with this soil in mapping are a few small areas of somewhat poorly drained Minoa soils that have fine sand, silt, and silt loam underlying material. Also included are small depressions in which there are finer textured, very poorly drained Barry and poorly drained Brookston soils.

Surface runoff is slow, permeability is moderately rapid, and the erosion hazard is slight. The principal concern of management is maintaining adequate drainage.

This soil is moderately well suited to crops and as woodland. Capability unit IIw—5 (4b); woodland suitability group 3w2.

Washtenaw Series

The Washtenaw series consists of poorly drained, nearly level soils in depressions on till plains and moraines. These soils formed in loamy overwash deposits, 20 to 40 inches thick, over buried loamy soils.

In a representative profile the surface layer is dark-gray silt loam 10 inches thick. The next layer, 12 inches thick, is mainly mottled dark-gray and very dark gray, firm silt loam, but the lower few inches is mottled, firm light sandy clay loam. Below this is 3 inches of very dark brown and very dark gray clay loam, 25 inches of very dark grayish-brown silt loam, and 10 inches of mottled dark-gray, very dark gray, and olive-gray loam. Below a depth of about 22 inches, the material is variable; it depends on the kind of material that was there when the upper material washed in.

Permeability is moderately slow. The available water capacity and fertility are high. Surface runoff is very slow to ponded.

If adequately drained, these soils are well suited to farming. They are moderately well suited as woodland. They have severe limitations for most nonfarm uses.

Representative profile of Washtenaw silt loam, in a cultivated field in SE¼NE¼NE¼ sec. 1, T. 4 N., R. 3 E.:

Ap—0 to 10 inches, dark-gray (10YR 4/1) silt loam; weak, fine, subangular blocky structure; friable; few brown (7.5YR 4/4) films on surface of peds; less than 5 percent coarse fragments; strongly acid; clear, wavy boundary.

C1g—10 to 19 inches, mottled dark-gray (10YR 4/1) and very dark gray (10YR 3/1) heavy silt loam; weak, thick, platy structure; firm; less than 5 percent coarse fragments; medium acid; clear, wavy boundary.

C2g—19 to 22 inches, mottled dark-gray (10YR 4/1) and grayish-brown (10YR 5/2) light sandy clay loam; weak, thick, platy structure; firm; less than 5 percent coarse fragments; slightly acid; clear, wavy boundary.

IIA1b—22 to 25 inches, mottled very dark brown (10YR 2/2) and very dark gray (10YR 3/1) clay loam; weak,

coarse, angular blocky structure; friable; dark-gray (10YR 4/1) clay films on surface of peds and along cracks and root channels; less than 5 percent coarse fragments; slightly acid; clear, wavy boundary.

IIB1gb—25 to 50 inches, very dark grayish-brown (10YR 3/2) silt loam; few, fine, faint, dark-brown (10YR 4/3) mottles; weak, medium, platy structure; firm; grayish-brown (10YR 5/2) sand coatings, less than ⅜-inch thick, along cracks; less than 5 percent coarse fragments; slightly acid; clear, wavy boundary.

IIB2g—50 to 60 inches, mottled dark-gray (5Y 4/1), very dark-gray (5Y 3/1), and olive-gray (5Y 4/2) loam; weak, medium, platy structure; slightly sticky, slightly plastic; less than 5 percent coarse fragments; mildly alkaline.

The Ap horizon is dark gray (10YR 4/1) or gray (10YR 5/1). The C horizon ranges from sandy loam to silty clay loam. The IIA1b and IIB1gb horizons range from loam to silty clay loam.

Washtenaw soils are similar to Barry and Berville soils but have a thicker solum than those soils.

Washtenaw silt loam (0 to 2 percent slopes) (Wh).—This soil is in drainageways and in small enclosed depressions on till plains and moraines. The areas are 1 to 5 acres in size. Slopes are nearly uniform.

Included with this soil in mapping are areas that have a sandy loam, loam, silty clay loam, or mucky surface layer. Also included are small areas of Carlisle soils.

Surface runoff is very slow to ponded. Some areas are ponded much of the year. Permeability is moderately slow, and the erosion hazard is slight. The principal concerns of management are maintaining adequate drainage and preventing ponding.

If adequately drained, this soil is well suited as cropland. It is moderately well suited as woodland. Capability unit IIw-4 (L-2c); woodland suitability group 3w3.

Use and Management of the Soils

This section gives an explanation of the nationwide capability classification system used by the Soil Conservation Service and discusses use and management of the soils for crops. It also includes a table showing predicted yields of the principal crops for most soils in the county under two levels of management. In addition, this section discusses use and management of the soils as woodland and for wildlife, engineering purposes, town and country planning, and recreation.

Capability Groups of Soils

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or engineering.

In the capability system, the kinds of soils are grouped at three levels: the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use. (None in Livingston County)

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, or water supply or to esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to

the subclass symbol, for example, IIe-2 or IIIe-6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

The capability classification of the soils in Livingston County is given in the "Guide to Mapping Units" at the end of this survey. For a complete explanation of the capability classification system, see Agriculture Handbook No. 210, Land-Capability Classification (*6*).

In this survey, symbols made up of Arabic numerals and small or capital letters follow the symbols of each capability unit. These symbols are in parentheses, and they identify the management group or groups, all or parts of which are represented by the soils in that capability unit. The management groups are part of a statewide system used in Michigan for making recommendations about applications of fertilizers, about drainage, and about other practices. For an explanation of this classification system, refer to "Fertilizer Recommendations for Vegetable and Field Crops in Michigan" (*3*).

Management by capability units [2]

In the following pages the capability units in Livingston County are described and suggestions for the use and management of the soils in each unit are given. The Arabic numerals used in this survey are not consecutive, because not all the capability units used in Michigan are represented in Livingston County.

Certain practices basic to good soil management can be mentioned before discussing the individual capability units. An adequate supply of plant nutrients and organic matter, a good root zone, and the proper balance of air and water are necessary to grow crops efficiently. Management practices needed to improve yields include drainage, control of erosion, rotation of crops, use of suitable crop varieties, and the adequate use of lime and fertilizer. Lime and fertilizer should be applied according to soil tests and the needs of the crops. Special care should be used where muck soils are fertilized.

Many of the soils in Livingston County, such as Brookston, Conover, and Gilford soils, need artificial drainage. Drainage of cropland improves the air-water relationship in the root zone. Spring planting, spraying, and harvesting are hampered and weed control is more difficult where drainage is poor. Tile drains or surface drainageways, or both, can be used to remove excess water, but they should be properly designed. Suitable outlets are difficult to find in some areas, particularly for Carlisle and Tawas soils. Diversions may be used in some areas to carry surface runoff away from wet areas. Good soil structure and an ample supply of organic matter also benefit soil drainage. The low-lying areas are subject to a shortened growing season because of frost in late spring and in early fall.

The loss of surface soil through erosion reduces soil productivity. This is common in steeper areas of Boyer, Fox, and Miami soils. Erosion can generally be controlled by reducing the rate and volume of runoff and by increasing the rate of water absorption by the soil. Surface runoff is reduced by growing meadow crops, cover crops, or green manure crops and by the proper use of crop residue. Contour cultivation, stripcropping, grassed waterways, minimum tillage, and the use of diversions and terraces are other measures effective in controlling erosion. Windbreaks help to control erosion on Carlisle, Houghton, and other muck soils and on Metea, Oakville, and other very sandy soils.

Practices that maintain and improve the organic-matter content and soil tilth include the growing of cover crops, stubble mulching, minimum tillage, the growing of green-manure crops, and the application of barnyard manure. Fall plowing on nearly level, poorly drained, or somewhat poorly drained soils, at the right moisture content, reduces damage to soil tilth and allows earlier tillage of the soils during the following spring. Fall plowing is beneficial for Brookston, Conover, and Pewamo soils. Grazing loamy and clayey soils when they are wet should be avoided because it results in compaction of the soil and poor tilth. Good soil practices are needed most if the rotation of crops is intensive or if the cultivation is continuous.

Additional help in managing the soils can be obtained by consulting the local representative of the Soil Conservation Service, or the Cooperative Extension Service.

The names of the soil series represented are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series appear in the unit. To find the name of each soil and the capability unit in which it has been grouped, refer to the "Guide to Mapping Units" at the end of this survey.

CAPABILITY UNIT IIe-2 (2.5a, 3a)

This unit consists of soils of the Conover, Hillsdale, and Miami series. The Miami and Hillsdale soils are well drained, and the Conover soil is somewhat poorly drained. One of the Miami soils is the only nearly level soil in the unit. The other soils are gently sloping. The Miami and Conover soils have a moderately fine textured subsoil underlain by medium-textured or moderately fine textured material. The Hillsdale soil has a moderately coarse textured and moderately fine textured subsoil underlain by moderately coarse material.

Permeability is moderate in the Hillsdale and Miami soils and moderately slow in the Conover soil. The available water capacity is moderate in the Hillsdale soil and high in the Miami and Conover soils. Surface runoff is slow. Fertility is medium to high. The major limitation to the use of these soils as cropland is the risk of erosion. The Conover soil has the additional limitations of wetness and poor soil tilth. The major concerns of management are controlling erosion and, for the Conover soil, providing adequate drainage and maintaining favorable tilth.

These soils are well suited to crops. Corn, wheat, soybeans, and some fruits are the main crops (fig. 5).

Random tile drainage is needed in areas of the Conover soil. In addition, some areas of the soils in this unit need surface drains to remove excess water in seep areas, drainageways, and wet depressions (fig. 6). Diversions on these soils will intercept runoff water and protect the lower lying soils from ponding.

[2] RICHARD H. DRULLINGER, agronomist, Soil Conservation Service, assisted in preparing this section.

Figure 5.—Preparing cropland for corn to be planted on a Miami loam in the foreground and on a Conover loam in the background.

Figure 6.—Corn is the major crop grown in the county. This corn is on Miami-Conover loams, 2 to 6 percent slopes. Included is a small low area of poorly drained Brookston loam, on which the corn has not grown.

CAPABILITY UNIT IIe-3 (2.5a, 3a, 3/2a)

This unit consists of soils of the Fox, Hillsdale, Miami, and Owosso series. These are well-drained, gently sloping soils. The Fox soil has a moderately fine textured subsoil that is underlain with coarse-textured material. The Hillsdale soil has a moderately coarse textured and moderately fine textured subsoil underlain with moderately coarse textured material. The Miami soil has a moderately fine textured subsoil underlain with medium-textured material. The Owosso soil is moderately coarse textured in the upper part of the subsoil and is moderately fine textured in the lower part. This is underlain by medium-textured material.

Permeability is moderate in the Fox, Hillsdale, and Miami soils. Permeability is moderately rapid in the upper layers of the Owosso soil and is moderately slow in the lower layers. The available water capacity is moderate in the Fox, Hillsdale, and Owosso soils and is high in the Miami soil. Surface runoff is slow. Natural fertility is medium in the Fox, Hillsdale, and Owosso soils and is high in the Miami soil. The major limitations to the use of these soils as cropland are susceptibility to erosion and, for the Fox, Hillsdale, and Owosso soils, moderate droughtiness. The major concerns of management are controlling erosion and improving and maintaining the organic-matter content and fertility.

These soils are well suited to crops. Corn, wheat, hay, and some fruit are the main crops.

Most of these soils can be tilled easily over a wide range of moisture content without clodding. The soils can be cropped intensively if fertility is maintained and erosion is controlled. Many areas do not have the long, continuous slopes that are necessary for contour farming and terracing. In these areas erosion must be controlled by growing cover crops and by minimum tillage.

CAPABILITY UNIT IIw-2 (1.5c)

Pewamo clay loam, the only soil in this unit, is poorly drained and nearly level. In some areas it occupies depressions or drainageways. This soil has a moderately fine textured subsoil and underlying material.

Permeability of this soil is moderately slow. The available water capacity is high. Runoff is slow to ponded. The natural fertility is high. The major limitations to the use of this soil are wetness and poor tilth. The major concerns of management are establishing drainage and improving and maintaining soil tilth.

If adequately drained, this soil is well suited to crops. Corn and hay are the main crops grown.

This soil is difficult to till because it can be tilled only within a limited range of moisture content. If the soil is cultivated when it is wet, it puddles, loses its granular structure, and becomes cloddy and hard as it dries. Artificial drainage is beneficial to most crops. Both surface and subsurface drainage are important. Ponding occurs on this soil in spring and after periods of heavy rainfall. Land smoothing and drainage field ditches are used for surface drainage, and tiling and open ditches provide subsurface drainage.

CAPABILITY UNIT IIw-4 (2.5a, 2.5b, 2.5c, L-2c)

This unit consists of soils of the Brookston, Colwood, Conover, Miami, and Washtenaw series. The Miami soils are well drained, the Conover soils are somewhat poorly drained, and the Brookston, Colwood, and Washtenaw soils are poorly drained. In some areas the Brookston soil occurs in depressions and in drainageways, as does the Washtenaw soil. Most of the soils have a moderately fine textured subsoil underlain by medium-textured or moderately fine textured material.

Soils in this unit are moderately slowly or moderately permeable. The available water capacity is high. Surface runoff is slow to ponded. Natural fertility is high. The major limitations to the use of these soils are poor tilth, as well as wetness in the Brookston, Conover, and Washtenaw soils. The major concerns of management are establishing drainage and maintaining favorable tilth. The Washtenaw soil is subject to ponding, particularly in the spring.

These soils are well suited to crops if the Brookston, Conover, and Washtenaw soils are drained. Corn, wheat, and hay are the main crops.

If most of these soils are tilled when wet, they compact and lose their granular structure and dry out cloddy and hard. Artificial drainage is needed for the best growth of crops. Both surface and subsurface drainage are needed in most areas. Water ponds in some areas in spring and after periods of heavy rainfall. The Colwood soil is unstable when wet. Tile lines can most readily be installed in this soil during dry periods. Special covering material over the tile lines is necessary to prevent silty material from filling the drains.

CAPABILITY UNIT IIw-5 (2.5b)

The only soil in this unit is Conover loam, 2 to 6 percent slopes. This soil has a moderately fine textured subsoil underlain by medium-textured or moderately fine textured material.

This soil is moderately slowly permeable. The available water capacity is high. Surface runoff is slow, and natural fertility is high. The major limitations to the use of this soil are wetness and poor soil tilth. Because of the gentle slopes, there is a slight hazard of erosion. The major concerns of management are establishing drainage and maintaining good tilth.

If drained, this soil is well suited to crops. Corn, wheat, and hay are the main crops.

If tilled when wet, this soil compacts and becomes cloddy as it dries. Unless drained, the soil has a seasonal high water table that is near the surface in spring. Random tile and surface drains help to remove excess water in undulating areas.

CAPABILITY UNIT IIw-6 (3b, 3c)

This unit consists of soils of the Barry, Locke, and Sebewa series. The Locke soil is somewhat poorly drained, the Sebewa soil is poorly drained, and the Barry soil is very poorly drained. The Locke soil is nearly level to gently sloping, and the others are nearly level. These soils have a moderately coarse textured to moderately fine textured subsoil underlain by moderately coarse textured or coarse textured material.

Permeability of these soils is moderate. The available water capacity is moderate. Surface runoff is slow or very slow, and water ponds in depressional areas. The soils have medium to high natural fertility. Excessive wetness is the major limitation to the use of these soils. The major concerns of management are establishing drainage and maintaining fertility.

If adequately drained, these soils are well suited to crops. Corn, soybeans, and hay are the main crops.

Installing tile drains is difficult in some areas because sandy material caves into the trenches. Tile lines can best be installed during dry periods. Special covering material over the lines and care in backfilling are necessary to prevent sandy material from flowing into and plugging tile drains.

CAPABILITY UNIT IIw-8 (3/2b, 3/2c)

This unit consists of soils of the Berville, Breckenridge, and Metamora series. The poorly drained Breckenridge and the very poorly drained Berville soils are nearly level. The Metamora soil is somewhat poorly drained and is nearly level to gently sloping. The soils in this unit have a moderately coarse textured or moderately fine textured subsoil underlain mostly by medium-textured and moderately fine textured material.

These soils are moderately slowly to moderately rapidly permeable. The available water capacity is moderate in the Metamora and Breckenridge soils and high in the Berville soil. Surface runoff is slow or very slow. Natural fertility is medium in the Breckenridge and Metamora soils and high in the Berville soil. Wetness is the major limitation to the use of these soils. The hazard of water erosion is slight in gently sloping areas of the Metamora soil. The major concerns of management are establishing drainage and maintaining fertility.

These soils are well suited to crops. Corn, wheat, oats, and hay are the main crops.

Unless drained, these soils have a seasonal high water table that is near the surface in spring and during prolonged wet periods. Random tile and surface drains remove the excess water in undulating areas. Tile lines are most easily installed during dry periods.

CAPABILITY UNIT IIw-10 (M/3c)

Only Linwood muck is in this unit. This soil occupies level or depressional areas. It consists of 12 to 40 inches of organic material underlain by layers of coarse-textured to medium-textured mineral material.

Permeability is moderately rapid in the organic material and moderately slow in the underlying mineral material. The available water capacity is very high. Surface runoff is very slow or ponded. The natural fertility is low. The major limitations to the use of this soil are excess wetness, low fertility, and susceptibility to soil blowing. The major concerns of management are establishing adequate drainage, improving fertility, and providing protection from soil blowing.

Much of this soil is not drained and is in native grasses, brush, and trees. If adequately drained, the soil is well suited to crops. Corn, vegetables, sod, and hay are the main crops.

Artificial drainage is needed before this soil can be cultivated intensively. The depth and spacing of the lines depend on the thickness of the organic material. Managing the level of the water table controls droughtiness, decreases subsidence, and reduces the hazard of soil blowing. Ditchbanks are unstable in this soil.

CAPABILITY UNIT IIs-2 (2.5a, 3a, 3/2a)

This unit consists of soils of the Fox, Miami, and Owosso series. These soils are well drained and nearly level. The Fox soil has a moderately fine textured subsoil underlain by coarse-textured material. The Miami soil has a moderately fine textured subsoil, and the Owosso soil has a moderately coarse textured and moderately fine textured subsoil. Both are underlain by medium-textured material.

The Fox and Miami soils are moderately permeable. The Owosso soil is moderately rapidly permeable in the upper layers and moderately slowly permeable in the lower layers. The available water capacity is moderate in the Fox and Owosso soils and high in the Miami soil. Surface runoff is slow. Natural fertility is medium in the Fox and Owosso soils and high in the Miami soil. The major limitations to the use of these soils are slight droughtiness and a slight hazard of soil blowing. The

major concerns of management are conserving moisture and maintaining fertility and the organic-matter content.

These soils are well suited to crops. Corn, wheat, oats, and hay are the main crops. Some fruit is grown on these soils.

CAPABILITY UNIT IIIe-5 (2.5a, 3a)

This unit consists of soils of the Hillsdale and Miami series. These soils are well drained and strongly sloping. The Hillsdale soil has a moderately coarse textured and moderately fine textured subsoil and is underlain with moderately coarse textured material. The Miami soils have a moderately fine textured subsoil underlain by medium-textured material.

Permeability is moderate. The available water capacity is moderate in the Hillsdale soil and high in the Miami soils. Surface runoff is medium. Natural fertility is medium in the Hillsdale soil and high in the Miami soils. The major limitation to the use of these soils is susceptibility to erosion. The major concerns of management are controlling erosion and maintaining fertility and the organic-matter content.

These soils are moderately well suited to crops. Corn, wheat, oats, and hay are the main crops. Some fruit also is grown.

CAPABILITY UNIT IIIe-6 (2.5a, 3a, 3/2a)

This unit consists of soils of the Fox, Hillsdale, Miami, and Owosso series. These soils are well drained and strongly sloping. The Fox and Miami soils have a moderately fine textured subsoil. The Hillsdale and Owosso soils have a moderately coarse textured or moderately fine textured subsoil. The Fox soil is underlain by coarse textured material, the Hillsdale soils by moderately coarse textured material, and the Miami and Owosso soils by medium-textured material.

Permeability is moderate in the Fox, Hillsdale, and Miami soils. The Owosso soil is moderately rapidly permeable in the upper layers and moderately slowly permeable in the lower layers. The available water capacity is high in the Miami soil and moderate in the Fox, Hillsdale, and Owosso soils. Surface runoff is medium. Natural fertility is medium in the Fox, Hillsdale, and Owosso soils and high in the Miami soil. The major limitations to the use of these soils are susceptibility to erosion and droughtiness during the growing season. The major concerns of management are controlling erosion and conserving moisture.

These soils are moderately well suited to crops. Corn, wheat, oats, and hay are the main crops. Some fruit also is grown.

CAPABILITY UNIT IIIe-9 (3a, 4a, 4/2a, 5a)

This unit consists of soils of the Arkport, Boyer, Fox, Metea, Oakville, Oshtemo, and Spinks series. These soils are well drained and strongly sloping. These soils have a coarse-textured to moderately fine textured subsoil. Their underlying material is mostly coarse textured, except for the Arkport and Metea soils, which have moderately coarse textured or medium-textured underlying material.

Permeability of these soils ranges from moderate to rapid. The available water capacity is low or moderate. Surface runoff is medium. Natural fertility is medium or low. The major limitations to the use of these soils are their susceptibility to erosion and their droughtiness. The Oakville and Spinks soils are more droughty than the other soils in the unit. The major concerns of management are controlling erosion, conserving moisture, and maintaining the organic-matter content and fertility.

The Oakville and Spinks soils are poorly suited to crops, but the other soils are moderately well suited. Corn, wheat, oats, and hay are the main crops.

CAPABILITY UNIT IIIw-5 (3b, 3c, 4b, 4c)

This unit consists of soils of the Brady, Gilford, Lamson, Minoa, Thetford, and Wasepi series. The Minoa and Thetford soils are gently sloping; the other soils are nearly level. The Gilford soil is very poorly drained, the Lamson soil is poorly drained, and the other soils are somewhat poorly drained. The soils in this unit have a subsoil that ranges from coarse to moderately fine in texture. Most are underlain by coarse-textured material, but the Lamson and Minoa soils are underlain by layers of coarse-textured and moderately fine textured material.

Permeability is moderate or moderately rapid. The available water capacity is moderate in Lamson and Minoa soils and low in the other soils. Surface runoff is slow. Natural fertility is low in the Thetford soil and medium in all the other soils.

If adequately drained, most of these soils are moderately well suited to crops. Corn and hay are the main crops.

The major limitation to the use of these soils is excess water or, if the soils are drained, droughtiness. The principal management needs are establishing adequate drainage, conserving moisture, and maintaining fertility.

On these soils, artificial drainage is beneficial to most crops. Both surface and subsurface drainage are important. In many places tile lines require special binding and careful backfilling to prevent sandy or silty material from flowing into and filling the drain. Tile drains and ditches in Lamson and Minoa soils should be installed during dry periods, because those soils are unstable when wet.

CAPABILITY UNIT IIIw-15 (Mc)

This unit consists of soils of the Carlisle, Houghton, and Rifle series. These soils are very poorly drained and nearly level. They consist of organic material more than 40 inches thick.

Permeability is moderately rapid. The available water capacity is very high. Surface runoff is very slow or ponded. Natural fertility is low. The major limitations to the use of these soils are wetness, low fertility, the frost hazard, and the hazard of soil blowing. The major concerns of management are establishing adequate drainage, maintaining adequate fertilization, and controlling soil blowing.

If drained, these soils are moderately well suited to crops. The Rifle soils are acid and require liming for the production of most crops. Corn, sugar beets, vegetable crops, and sod are the main crops.

Artificial drainage and control of the water table are necessary if these soils are to be used as cropland. The water level can be controlled in most areas with the use of dams, dikes, subirrigation through tile lines, pumps, irrigation wells, and tile and open ditch drainage. A high water table is more easily tolerated in areas used for grassland farming than in areas used for specialty crops.

Tile drainage can be difficult to install in the organic materials because these materials do not provide a stable foundation. Ditchbanks in these soils cave in readily, and frequent maintenance is required.

CAPABILITY UNIT IIIs-3 (3a, 4a, 4/2a, 5a)

This unit consists of soils of the Arkport, Boyer, Bronson, Metea, Oakville, Oshtemo, Ottokee, and Spinks series. The Oakville and Spinks soils are nearly level or gently sloping; the rest of the soils are nearly level. All the soils are well drained or moderately well drained. They have a coarse-textured to moderately fine textured subsoil. Their underlying materials are mostly coarse textured, but the Arkport and Metea soils, as well as one of the Boyer soils, have moderately coarse textured or medium-textured underlying material.

Permeability of the soils in this unit ranges from moderate to rapid. The available water capacity is low or moderate. Surface runoff is slow. Natural fertility is medium or low. The major limitations to the use of these soils are droughtiness, the hazard of soil blowing, and the difficulty of maintaining fertility and the organic-matter content. The Oakville and Spinks soils are more droughtly than the other soils. The major concerns of management are conserving moisture, controlling soil blowing, and maintaining adequate organic matter and fertility.

These soils are moderately well suited to crops, except for the Oakville and Spinks soils, which are poorly suited. Corn, wheat, oats, and hay are the main crops.

CAPABILITY UNIT IIIs-4 (3a, 4a, 4/2a, 5a)

This unit consists of soils of the Arkport, Boyer, Fox, Metea, Oshtemo, and Ottokee series. These soils are well drained and moderately well drained and are gently sloping. They have a coarse-textured to moderately fine textured subsoil. Their underlying materials are mostly coarse textured, but the Arkport and Metea soils, as well as one of the Boyer soils, have moderately coarse textured or medium-textured underlying material.

Permeability of the soils in this unit ranges from moderate to rapid. The available water capacity is moderate or low. Surface runoff is slow. Natural fertility is medium or low. The major limitations to the use of these soils are droughtiness, the erosion hazard, and the difficulty in maintaining organic matter and fertility. The major concerns of management are conserving moisture, controlling erosion, and maintaining adequate organic matter and fertility.

These soils are moderately well suited to crops, except for the Fox soil, which is well suited. Corn, wheat, oats, and hay are the main crops. Crops that resist drought and mature early in the growing season are suited to these soils.

CAPABILITY UNIT IVe-4 (2.5a, 3a, 3/2a)

This unit consists of soils of the Hillsdale, Miami, and Owosso series. These soils are well drained and hilly. The Hillsdale soil has a moderately coarse textured and moderately fine textured subsoil underlain by moderately coarse textured material. The Miami soils have a moderately fine textured subsoil underlain by medium-textured material. The Owosso soil is moderately coarse textured in the upper part of the subsoil and moderately fine textured in the lower part. It is underlain by medium-textured material.

Permeability is moderate in the Hillsdale and Miami soils. It is moderately rapid in the upper layers of the Owosso soil and moderately slow in the lower layers. The available water capacity is moderate in the Hillsdale and Owosso soils and high in the Miami soil. Surface runoff is rapid. Natural fertility is medium in the Hillsdale and Owosso soils and high in the Miami soils. The major limitation to the use of these soils is the hazard of water erosion. There is a moderate limitation to the use of equipment because of slope. The major concern of management is controlling erosion.

Most areas of these soils are either idle, in pasture, or in woodland. The soils are poorly suited to row crops. They are moderately well suited to small grains and are well suited to the production of hay crops. Oats and hay are the main crops.

CAPABILITY UNIT IVe-9 (3a, 4a, 5a)

This unit consists of soils of the Boyer, Fox, Oakville, Oshtemo, and Spinks series. These soils are well drained and hilly. The subsoil of these soils ranges from coarse textured to moderately fine textured and is underlain by coarse-textured material.

Permeability of these soils is moderate to rapid. The available water capacity is moderate in the Fox soil and low in the other soils. Surface runoff is medium to rapid. Natural fertility is medium in the Fox soil and low in the other soils. The major limitations to the use of these soils are the erosion hazard, droughtiness, and the difficulty of maintaining organic matter and fertility. There is a moderate limitation to the use of equipment because of steep slopes. The major concerns of management are controlling erosion, conserving moisture, and maintaining organic matter and fertility.

Most areas of these soils are idle, in pasture, or in woodland. These soils are poorly suited to cultivated crops. They are moderately well suited to small grains and hay crops. Oats and hay are the main crops.

CAPABILITY UNIT IVw-5 (M/4c)

The only soil in this unit is Tawas muck. This soil is very poorly drained and nearly level. It consists of 12 to 40 inches of organic material underlain by coarse-textured material.

Permeability is moderately rapid. The available water capacity is moderate. Surface runoff is very slow or ponded. Natural fertility is low. The major limitations to the use of this soil are excess wetness, susceptibility to soil blowing, low fertility, and in some areas, a frost hazard. The major concerns of management are establishing adequate drainage, improving fertility, and controlling soil blowing.

Much of this soil is not drained and is in native grasses, brush, and trees. In some places the soil is used for sugar beets. It is poorly suited to crops.

Artificial drainage is necessary before this soil is cultivated. The depth and spacing of tile depend on the thickness of the organic material. Tile and open-ditch drainage are difficult in many areas because the unstable organic material and sands do not provide suitable foundations

for tile lines or stable side slopes for open ditches. Managing the level of the water table by use of tile and open-ditch drainage, pumps, and irrigation controls droughtiness, decreases subsidence, and reduces soil blowing.

CAPABILITY UNIT IVw-6 (M/mc)

In this unit are soils of the Edwards and Warners series. These soils are very poorly drained and nearly level. The Edwards soil consists of 12 to 40 inches of organic material over marl. The Warners soil consists of 12 inches or less of mineral material over marl.

Permeability is variable. The available water capacity is high. Surface runoff is very slow to ponded. Natural fertility is low. The major limitations to the use of these soils are wetness, low natural fertility, and the undesirable physical and chemical properties of the underlying marl. The major concerns of management are establishing adequate drainage, improving fertility, and controlling soil blowing.

These soils are poorly suited to crops. Some areas of the Edwards soil are used for vegetable crops and sod.

Artificial drainage is needed before these soils can be cultivated. Careful investigation is necessary before the soils are drained because of differences in the stability and depth of the underlying marl. Areas in which marl is at shallow depths should generally be left in permanent vegetation. In the areas where the organic material is more than 18 inches thick, vegetable crops and sod may be grown. The presence of marl causes some deficiencies in major and minor nutrients. Because of the lack of stability in these soils, ditchbanks need frequent maintenance.

CAPABILITY UNIT IVs-4 (5a, 5/2a)

This unit consists of Oakville fine sand, 0 to 6 percent slopes, and Oakville fine sand, loamy substratum, 0 to 6 percent slopes. These soils are well drained and are coarse textured throughout, except that Oakville fine sand loamy substratum, 0 to 6 percent slopes, is underlain by medium-textured material at a depth of 40 to 66 inches.

Permeability is rapid. The available water capacity is low. Surface runoff is slow. Natural fertility is low. The major limitations to the use of these soils are droughtiness, low fertility, and susceptibility to soil blowing. The major concerns of management are conserving moisture, improving fertility, and controlling soil blowing.

Most areas of these soils are idle or in native grasses or brush. The soils are poorly suited to crops. Oats, hay, and fruit are the main crops grown.

Frequent additions of crop residues, manure, and green manure are helpful in conserving soil moisture and maintaining the organic-matter content. Minimum tillage and tillage that keeps crop residues or green manure at or near the surface also help to conserve moisture, limit soil blowing, and maintain the organic-matter content.

CAPABILITY UNIT Vw-1 (L-2c)

Only Alluvial land is in this unit. This land type is nearly level or depressional. It is generally somewhat poorly drained to very poorly drained but ranges to well drained in some areas. Alluvial land is adjacent to streams and periodically is flooded, especially in spring and after periods of heavy rainfall. It ranges from moderately coarse to moderately fine in texture.

Permeability ranges from rapid to moderately slow. The available water capacity ranges from moderate to low. Surface runoff is very slow or ponded. Natural fertility ranges from medium to high. The major limitations to the use of this land type are wetness in many areas, the hazard of flooding, and the small size and isolation of the areas. It is difficult to reach many areas with farm machinery because of meandering streams, old oxbows, and adjacent steep slopes. The major concerns of management are establishing adequate drainage, protecting the land from flooding, and improving accessibility.

Most areas of Alluvial land are in native grasses, brush, or woodland. Some small areas are used for pasture. The land is poorly suited to crops.

Care is needed to prevent overgrazing, to keep from compacting the surface layer, and to prevent streambank erosion.

CAPABILITY UNIT VIe-2 (2.5a, 3a, 4a, 5a)

This unit consists of soils of the Boyer, Fox, Hillsdale, Miami, Oakville, Oshtemo, and Spinks series. These soils are well drained and steep. They have a coarse-textured to moderately fine textured subsoil. The Miami soil is underlain by medium-textured material, the Hillsdale soil by moderately coarse textured material, and the other soils by coarse textured material.

Permeability of these soils ranges from moderate to rapid. The available water capacity ranges from low to high. Surface runoff is medium or rapid. Natural fertility ranges from low to high. The major limitations to the use of these soils are the erosion hazard and steep slopes. The major concern of management is controlling erosion.

Most areas of these soils have been cultivated but are now idle or in woodland. The soils are not suited to row crops or small grains but are moderately suited to hay and pasture.

Vegetative cover should be maintained on these soils at all times to control erosion.

CAPABILITY UNIT VIIe-2 (2.5a, 3a, 4a, 5a)

This unit consists of soils of the Boyer, Fox, Miami, Oakville, Oshtemo, and Spinks series. These soils are well drained and very steep. They have a coarse-textured to moderately fine textured subsoil. The Miami soil is underlain by medium-textured material, and the other soils by coarse-textured material.

Permeability of these soils ranges from moderate to rapid. The available water capacity ranges from high to low. Surface runoff is medium or rapid. Natural fertility ranges from low to high. The major limitations to the use of these soils are the severe hazard of erosion and the very steep slopes. The major concern of management is controlling erosion.

Most areas of these soils are in woodland. A few areas were once cleared for farming but now are idle and growing up to grass and brush. The soils are not suited to crops and are only poorly suited as pasture.

The severe risk of erosion on these soils can be reduced by maintaining a protective cover of grass or trees at all times, by proper seeding or planting, and by regulated mowing and grazing.

CAPABILITY UNIT VIIIs-1

This unit consists of Borrow pits, Gravel pits, Lake beaches, and Made land. These are miscellaneous land types that are not suitable for farming.

Borrow pits and Gravel pits are areas from which soil material has been removed and used as fill material or sand and gravel. Some of these pits contain water and have some potential for recreational purposes or as a limited source of water. Lake beaches are very low in fertility, very droughty, and highly erodible. Their potential use is for recreational and esthetic purposes. Made land consists of areas that have been covered with fill material of variable composition or areas in which the soil profile has been destroyed. Most areas of Made land are used for commercial or residential purposes.

Predicted Yields

The soils of Livingston County vary considerably in productivity. Some consistently produce higher yields of cultivated crops, but others are better suited to less intensive uses because of soil limitations or the erosion hazard.

Predictions of average acre yields of the principal crops grown on most soils in the county are given in table 2. The following mapping units are not suited to crops, pasture, or hay and are not listed in table 2: Alluvial land; Borrow pits; Boyer-Oshtemo loamy sands, 25 to 35 percent slopes; Edwards muck; Gravel pits; Houghton muck; Lake beaches; Made land; Miami loam, 25 to 35 percent slopes; Spinks-Oakville loamy sands, 25 to 35 percent slopes; Tawas muck; and Washtenaw silt loam.

The yields listed in table 2 are obtained under two levels of management—prevailing management and improved management. In columns A are the averages of recorded yields of crops grown under prevailing, or common, management. At this level of management, some legume-grass is grown in the crop rotations. Generally, little consideration is given to the suitability of the rotation for the soil. Barnyard manure that is produced is returned to the soil. Lime is applied but commonly in insufficient amounts and not according to the results of soil tests. Some fertilizer is applied. Poorly drained areas are worked while wet, and in many places only a partial crop is harvested because of excess water. Erosion control and proper soil management are not used to the fullest advantage.

In columns B are the averages for crops grown under improved management. The level of management includes most of the following practices: the crop rotation is adapted to the soil and has the proper proportion of row crops to legume-grass crops. The rotation is supplemented by the conservation measures needed to control soil blowing and water erosion. Among these measures are contour tillage, stripcropping, minimum tillage, and return of crop residues to the soil. The quantity of lime applied is determined by soil tests. Fertilizer application is also determined by soil tests and is based on the amounts and kinds of plant food needed by the crop. Where needed, an adequate system of artificial drainage is installed. Improved varieties of plants and seeds of high quality are used. Weeds, diseases and insects are controlled. Suitable methods and proper timing of tillage and harvesting are used. Cover crops, crop residues, and manure are returned to improve soil structure, supply organic matter, and control erosion.

The crop yields listed in table 2 are those that are expected over a period of several years under the two defined levels of management. The yields under improved management are not presumed to be the maximum obtainable. Potential yields per acre are somewhat higher, especially if there is favorable combination of soil, plant, and weather conditions. Irrigation is not considered a part of improved management, because this practice is limited mainly to the production of truck and fruit crops.

These yields are useful in showing the relative productivity of the soils in Livingston County. The actual figures are likely to become outdated with the passing of time, but they serve as a guide to the relationship of the soils to each other.

Woodland [3]

This section describes the original and present woodland in Livingston County. It also defines woodland suitability groups and explains the system of grouping used by the Soil Conservation Service. In the discussions of each group, the soils in the group are described and potential productivity of specified trees is given. Hazards to woodland management are rated. In addition, trees to favor in existing stands and those preferred in planting are named.

Original and present woodland

Livingston County originally was covered almost entirely by forest. Mixed hardwoods grew on the uplands, and swamp hardwoods and conifers on the lowlands. In a few areas in the northern part of the county, white pine grew on well-drained, sandy soils.

Nearly all of the original forest in the county has been cut. In wooded areas the well-drained, sandy soils are covered by second-growth mixed hardwoods. Wooded areas of the better drained, medium-textured to fine-textured soils are mainly covered by stands of oak and hickory and by sugar maple, ash, cherry, beech, basswood, and elm.

The vegetation on the timbered, poorly drained mineral soils is now mainly elm and red maple. Aspen, white-cedar, tamarack, elm, and red maple are the dominant trees on timbered organic soils. About 26 percent of the county is now woodland.

Woodland suitability groups

The soils of Livingston County have been placed in 11 woodland suitability groups to assist owners in planning the use of their soils for wood crops. Because the woodland groups are established on a statewide basis, not all groups are present or described in Livingston County. Miscellaneous land type units (Alluvial land, Borrow pits, Gravel pits, Lake beaches, and Made land) are not placed in a woodland suitability group. Management of these areas requires specific recommendations from local soil conservationists or forestry technicians.

---

[3] By JACQUES J. PINKARD, woodland conservationist, Soil Conservation Service.

TABLE 2.—*Predicted average yields per acre of crops under two levels of management*

[Yields in columns A are those expected under common management; those in columns B are those expected under improved management. Dashes indicate that the soil is not suited to the crop or that the crop ordinarily is not grown]

Soil	Corn For grain A	Corn For grain B	Corn For silage A	Corn For silage B	Oats A	Oats B	Wheat A	Wheat B	Alfalfa A	Alfalfa B	Mixed hay A	Mixed hay B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Arkport fine sandy loam, 0 to 2 percent slopes	40	65	7	11	25	45	20	37	2.5	3.5	1.0	2.5
Arkport fine sandy loam, 2 to 6 percent slopes	40	65	7	11	25	45	20	37	2.5	3.5	1.0	2.5
Arkport fine sandy loam, 6 to 12 percent slopes	35	57	6	10	20	45	20	35	2.5	3.5	1.0	2.5
Barry sandy loam	70	90	12	15	50	70	35	48	2.5	4.3	1.7	2.8
Berville loam	65	85	11	14	45	65	32	45	2.5	4.3	1.7	2.8
Boyer loamy sand, 0 to 2 percent slopes	40	60	7	10	30	45	25	38	2.4	3.7	1.0	2.7
Boyer loamy sand, 2 to 6 percent slopes	35	60	6	10	30	45	25	38	2.4	3.7	1.0	2.7
Boyer loamy sand, 6 to 12 percent slopes	30	55	5	10	30	45	25	38	2.4	3.7	1.0	2.7
Boyer loamy sand, silty substratum, 0 to 2 percent slopes	42	65	7	11	32	47	26	40	2.4	3.7	1.0	2.7
Boyer loamy sand, silty substratum, 2 to 6 percent slopes	42	65	7	11	32	47	26	40	2.4	3.7	1.0	2.7
Boyer-Oshtemo loamy sands, 0 to 2 percent slopes	40	65	7	11	30	50	25	40	2.4	3.8	1.1	2.8
Boyer-Oshtemo loamy sands, 2 to 6 percent slopes	40	65	7	11	30	50	25	40	2.4	3.8	1.1	2.8
Boyer-Oshtemo loamy sands, 6 to 12 percent slopes	35	60	6	10	25	47	25	38	2.2	3.5	1.0	2.7
Boyer-Oshtemo loamy sands, 12 to 18 percent slopes	----	----	----	----	25	40	20	35	2.2	3.4	.8	2.5
Boyer-Oshtemo loamy sands, 18 to 25 percent slopes	----	----	----	----	----	----	----	----	1.9	3.2	.7	2.4
Brady loamy sand, 0 to 2 percent slopes	50	65	8	11	35	55	30	42	2.5	4.0	1.5	2.8
Breckenridge loamy sand	50	65	8	11	35	55	30	42	2.5	4.0	1.5	2.8
Bronson loamy sand, 0 to 2 percent slopes	45	65	7	11	35	55	30	40	2.5	3.8	1.0	2.7
Brookston loam	80	105	13	16	60	80	40	50	2.8	4.5	1.7	2.8
Carlisle muck	60	80	10	13	----	----	----	----	----	----	1.7	2.9
Colwood fine sandy loam	75	100	12	15	50	75	35	50	2.8	4.5	1.7	2.6
Conover loam, 0 to 2 percent slopes	75	100	12	15	50	75	35	50	2.8	4.5	1.7	2.6
Conover loam, 2 to 6 percent slopes	65	92	11	15	40	70	30	48	2.6	4.3	1.7	2.6
Conover-Miami loams, 0 to 2 percent slopes	70	90	12	15	50	65	35	50	3.0	4.5	1.5	2.5
Fox sandy loam, 0 to 2 percent slopes	60	85	10	14	45	55	30	45	2.7	4.0	1.2	2.7
Fox sandy loam, 2 to 6 percent slopes	60	85	10	14	40	55	30	45	2.7	4.0	1.2	2.7
Fox sandy loam, 6 to 12 percent slopes	50	80	8	13	30	50	25	40	2.7	4.0	1.2	2.7
Fox-Boyer complex, 2 to 6 percent slopes	45	70	6	11	30	50	25	40	2.7	4.0	1.2	2.7
Fox-Boyer complex, 6 to 12 percent slopes	40	65	6	11	30	50	25	40	2.7	4.0	1.2	2.7
Fox-Boyer complex, 12 to 18 percent slopes	----	----	----	----	20	45	20	37	2.2	4.0	1.0	2.5
Fox-Boyer complex, 18 to 25 percent slopes	----	----	----	----	----	----	----	----	2.0	3.7	.9	2.2
Gilford sandy loam	50	75	8	12	40	65	30	45	2.5	3.8	1.0	2.8
Hillsdale loamy sand, 2 to 6 percent slopes	40	65	7	11	25	45	20	37	2.7	4.0	1.2	2.7
Hillsdale loamy sand, 6 to 12 percent slopes	35	60	6	10	20	45	20	35	2.7	4.0	1.2	2.7
Hillsdale sandy loam, 2 to 6 percent slopes	50	80	8	13	30	50	25	40	2.7	4.0	1.2	2.7
Hillsdale sandy loam, 6 to 12 percent slopes	45	75	7	12	30	45	22	38	2.7	4.0	1.2	2.7
Hillsdale sandy loam, 12 to 18 percent slopes	----	----	----	----	20	40	20	35	2.5	3.7	1.0	2.5
Hillsdale sandy loam, 18 to 25 percent slopes	----	----	----	----	----	----	----	----	1.7	3.5	.8	2.2
Hillsdale-Miami loams, 2 to 6 percent slopes	70	85	11	14	40	60	30	45	3.0	4.5	1.5	2.5
Hillsdale-Miami loams, 6 to 12 percent slopes	65	75	11	13	35	55	25	42	3.0	4.5	1.5	2.5
Lamson fine sandy loam	60	80	10	14	45	65	30	45	2.7	4.2	1.6	2.5
Linwood muck	60	80	10	13	----	----	----	----	----	----	1.7	2.9
Locke sandy loam, 0 to 4 percent slopes	70	90	12	15	45	70	32	47	2.8	4.5	1.7	2.6
Metamora sandy loam, 0 to 4 percent slopes	60	82	10	13	40	65	30	42	2.7	4.2	1.7	2.5
Metea loamy sand, 0 to 2 percent slopes	42	65	7	11	35	50	27	42	2.5	3.8	1.2	2.8
Metea loamy sand, 2 to 6 percent slopes	38	65	6	11	35	50	25	42	2.5	3.8	1.2	2.8
Metea loamy sand, 6 to 12 percent slopes	35	62	6	11	35	47	25	40	2.5	3.8	1.2	2.8
Miami loam, 0 to 2 percent slopes	70	90	11	15	50	65	35	50	3.0	4.5	1.5	2.5
Miami loam, 2 to 6 percent slopes	70	90	11	15	50	65	35	50	3.0	4.5	1.5	2.5
Miami loam, 6 to 12 percent slopes	60	85	10	14	45	65	30	45	3.0	4.5	1.5	2.5
Miami loam, 12 to 18 percent slopes	----	----	----	----	30	45	20	40	2.5	4.2	1.0	2.3
Miami loam, 18 to 25 percent slopes	----	----	----	----	----	----	----	----	2.0	3.7	.9	2.0
Miami-Conover loams, 2 to 6 percent slopes	65	90	11	15	45	65	30	50	3.0	4.5	1.5	2.5
Minoa-Thetford complex, 0 to 4 percent slopes	50	65	8	11	35	55	30	42	2.5	4.0	1.5	2.8
Oakville fine sand, 0 to 6 percent slopes	20	45	4	7	20	40	20	27	2.0	2.7	.7	1.4
Oakville fine sand, loamy substratum, 0 to 6 percent slopes	22	42	4	7	22	38	20	25	2.0	3.0	.9	1.9
Ottokee loamy sand, 0 to 2 percent slopes	35	60	6	10	30	45	25	40	2.5	3.9	1.2	2.8

TABLE 2.—*Predicted average yields per acre of crops under two levels of management*—Continued

Soil	Corn				Oats		Wheat		Alfalfa		Mixed hay	
	For grain		For silage									
	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Ottokee loamy sand, 2 to 6 percent slopes	30	55	5	9	30	40	20	35	2.5	3.9	1.2	2.8
Owosso-Miami sandy loams, 0 to 2 percent slopes	65	85	11	14	47	62	32	47	3.0	4.4	1.5	2.4
Owosso-Miami sandy loams, 2 to 6 percent slopes	65	85	11	14	47	62	32	47	3.0	4.4	1.5	2.4
Owosso-Miami sandy loams, 6 to 12 percent slopes	60	80	10	13	42	58	30	45	3.0	4.3	1.5	2.4
Owosso-Miami sandy loams, 12 to 18 percent slopes	---	---	---	---	40	52	27	42	3.0	4.3	1.5	2.4
Pewamo clay loam	80	100	13	16	55	75	37	47	2.7	4.4	1.6	2.7
Sebewa loam	65	90	11	15	45	70	32	47	2.8	4.5	1.7	2.7
Spinks-Oakville loamy sands, 0 to 6 percent slopes	35	55	6	10	22	42	18	34	2.4	3.2	.9	2.4
Spinks-Oakville loamy sands, 6 to 12 percent slopes	30	50	5	9	20	40	17	32	2.4	3.2	.9	2.4
Spinks-Oakville loamy sands, 12 to 18 percent slopes	---	---	---	---	---	---	---	---	2.2	3.0	.8	2.2
Spinks-Oakville loamy sands, 18 to 25 percent slopes	---	---	---	---	---	---	---	---	1.8	3.0	.7	2.0
Wasepi sandy loam, 0 to 2 percent slopes	45	75	7	13	37	60	28	42	2.3	3.5	.9	2.7

Each woodland suitability group consists of kinds of soils that are capable of producing similar kinds of wood crops, that need similar management to produce these crops where existing vegetation is similar, and that have about the same potential productivity. The factors considered in placing each soil in a woodland group include potential productivity, which is expressed as the site index; species to favor in management of existing stands; trees preferred for planting; and soil-related hazards and major limitations to be considered in management. These factors are explained in the paragraphs that follow.

The potential productivity of a soil for a given species is commonly expressed as the site index. It is the height in feet that the dominant trees of a given species, growing on a specified soil, will reach in a natural, unmanaged stand in a stated number of years. On the basis of the site index, rates of growth can be calculated. The International ¼-inch rule is used in measuring board feet of lumber produced in Livingston County.

The hardwoods have been grouped as follows:

Upland oaks: white oak (*Quercus alba*), bur oak (*Quercus macrocarpa*), black oak (*Quercus velutina*), and northern red oak (*Quercus rubra*).

Lowland hardwoods: silver maple (*Acer saccharinum*), red maple (*Acer rubrum*), swamp white oak (*Quercus bicolor*), and pin oak (*Quercus palustris*).

Aspen: quaking aspen (*Populus tremuloides*), together with combinations of the foregoing hardwoods and an occasional paper birch (*Betula papyifera*).

Species to favor in management of existing stands for each woodland suitability group are listed in order of priority, the first species listed having the highest priority. The species are selected on the basis of their adaptability or tolerance and their productivity and commercial value. They should be given the most consideration when making improvement cutting.

Trees preferred for planting are the most suitable trees for open-field and woodland interplanting on the soils in each woodland group. If it is desired to plant trees other than those listed for planting, the most likely to succeed or to be worth growing are those trees to favor in existing stands. Trees are not commonly planted on somewhat poorly drained and poorly drained soils, unless the soils have been artificially drained.

Each woodland group is identified by a three-part symbol, such as Ao1, 3s5, or 4w1. The first part of the symbol, always a number, indicates relative potential productivity of the soils in the group: 1 is very high, 2 is high, 3 is moderately high, 4 is moderate, and 5 is low. Potential productivity for organic soils is extremely variable and is indicated in the woodland group symbol by a dash. The ratings of potential productivity are based on field determinations of the average site index.

The second part of the symbol identifying a woodland group is a small letter. This letter indicates an important soil property that imposes a moderate or severe hazard or limitation in managing the soils of the group for wood crops. The letter *o* shows that the soils have few limitations that restrict their use for trees; *s* shows that the soils are sandy and dry, have low available water capacity, and generally have a low supply of plant nutrients; and *w* shows that water in or on the soils, either seasonally or year round, is the chief limitation. The last part of the symbol, another number, identifies the woodland suitability group.

Erosion hazard refers to the potential hazard of soil losses by wind or water in well-managed woodland. Considered in the ratings are texture of the surface layer and slope. The hazard is slight if expected soil losses are

small; moderate if some soil losses are expected and care is needed during logging and construction to reduce the risk of erosion; and severe if special methods of operation are necessary for preventing excessive soil losses.

Equipment limitations are rated on the basis of soil characteristics that restrict or prohibit the use of equipment commonly used in tending and harvesting the trees. In Livingston County, soil characteristics having the most limiting effect are drainage, depth to the water table, and steep to very steep slopes. Slight means there is no restriction in the kind of equipment or in the time of year it is used; moderate means that use of equipment is restricted for less than 3 months of the year; and severe means that special equipment is needed and its use is restricted for more than 3 months of the year.

Seedling mortality refers to the expected mortality of naturally occurring or planted seedlings as influenced by kinds of soil where plant competition is not a limiting factor. Considered in the ratings are drainage, effective rooting depth, and texture of the surface layer. Normal rainfall, good planting stock, and proper planting are assumed. A rating of slight indicates an expected loss of less than 25 percent of the seedlings, and severe indicates a loss of more than 50 percent.

Plant competition refers to invasion by or growth of undesirable species when openings are made in the tree canopy. Considered in the ratings are available water capacity, fertility, and drainage. A rating of slight means that competition from other plants is not a problem; moderate, that plant competition generally does not prevent development of fully stocked stands of desirable trees; and severe, that plant competition prevents establishment of a desirable stand unless intensive site preparation and maintenance are used to control undesirable plants.

Windthrow hazard, or the danger of trees being blown over by wind, is an evaluation of soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. The hazard is slight if the trees withstand wind; moderate if some trees are blown down during periods of excessive soil wetness and strong wind; and severe, if many trees are blown down during periods of excessive soil wetness and moderate or strong wind.

In the following pages the woodland suitability groups in Livingston County are described.

WOODLAND SUITABILITY GROUP 2o1

This group consists of well-drained soils of the Fox, Miami, and Owosso series. These soils have a moderately coarse textured or medium-textured surface layer and generally a moderately fine textured subsoil. They have medium to high fertility and moderate to high available water capacity. The slope range is 0 to 18 percent. These soils are well suited to the production of hardwoods.

The site index for upland oaks is 75 to 85, and the expected yield is 275 to 325 board feet or more per acre per year for a stand at 70 years of age. Competition from other plants is moderate on these soils. All other limitations are slight.

Species to favor in existing stands are black walnut, red oak, white oak, white ash, sugar maple, and black cherry. Trees preferred for planting are black walnut, yellow-poplar, and white pine.

WOODLAND SUITABILITY GROUP 2o2

This group consists of well-drained soils of the Fox and Miami series. These soils have a moderately coarse textured or medium-textured surface layer and a moderately fine textured subsoil. They have medium to high fertility and moderate to high available water capacity. The slope range is 18 to 40 percent. These soils are well suited to the production of hardwoods.

The site index for upland oaks is 75 to 85, and the expected yield is 275 to 325 or more board feet per acre per year for a stand at 70 years of age. The erosion hazard, equipment limitations and competition from other plants are moderate on these soils. Seedling mortality and the windthrow hazard are slight.

Species to favor in existing stands are black walnut, red oak, white ash, white oak, sugar maple, and black cherry. The trees preferred for planting are black walnut, yellow-poplar, and white pine.

WOODLAND SUITABILITY GROUP 3o3

This group consists of well-drained soils of the Hillsdale series. These soils have a coarse-textured to medium-textured surface layer and a moderately coarse textured and moderately fine textured subsoil. They have medium fertility and a moderate available water capacity. The slope range is 0 to 18 percent. These soils are moderately well suited to the production of hardwoods.

The site index for upland oaks is 65 to 75, and the expected yield is 200 to 275 board feet per acre per year for a stand at 80 years of age. Competition from other plants is moderate on these soils. All other limitations are slight.

Species to favor in existing stands are black walnut, red oak, white ash, sugar maple, basswood, white oak, black cherry, and yellow-poplar. White spruce and Norway spruce are preferred for planting in windbreaks.

WOODLAND SUITABILITY GROUP 3o4

Hillsdale sandy loam, 18 to 25 percent slopes, is the only soil in this group. These soils have a moderately coarse textured surface layer and a moderately coarse textured and moderately fine textured subsoil. They have medium fertility and a moderate available water capacity. The slope range is 18 to 25 percent. These soils are moderately well suited to the production of hardwoods.

The site index for upland oaks is 65 to 75, and the expected yield is from 200 to 275 board feet per acre per year for a stand at 80 years of age. The erosion hazard, equipment limitations, and plant competition are moderate. Seedling mortality and the windthrow hazard are slight on those soils.

Species to favor in existing stands are black walnut, red oak, white ash, sugar maple, basswood, white oak, black cherry, and yellow-poplar. White spruce and Norway spruce are preferred for planting in windbreaks.

WOODLAND SUITABILITY GROUP 3s5

This group consists of well drained or moderately well drained soils of the Arkport, Boyer, Bronson, Metea, Oakville, Oshtemo, Ottokee, and Spinks series. These soils have a moderately coarse textured or coarse textured surface layer and a coarse textured to moderately fine textured subsoil. Most of them have low fertility and low available water capacity. The slope range is 0 to 18 per-

cent. These soils are moderately well suited to the production of hardwoods and are well suited to the production of pines.

The site index for upland oaks is 65 to 75, and the expected yield is 200 to 275 board feet per acre per year for a stand at 80 years of age. The site index for red pine is 65 to 75, and the expected yield is 325 or more board feet per acre per year for a stand at 60 years of age. Seedling mortality is slight to moderate, and all other limitations are slight.

Species to favor in existing stands are red oak, white oak, basswood, aspen, and white pine. Trees preferred for planting are white pine, red pine, and white spruce.

WOODLAND SUITABILITY GROUP 3s6

This group consists of well-drained soils of the Boyer, Oakville, Oshtemo, and Spinks series. These soils have a coarse-textured surface layer and a coarse-textured to moderately fine textured subsoil. They have low fertility and low available water capacity. The slope range is 18 to 40 percent. These soils are moderately well suited to the production of hardwoods and are well suited to the production of pine.

The site index for upland oaks is 65 to 75, and the expected yield is 200 to 275 board feet per acre per year for a stand at 80 years of age. The site index for red pine is 65 to 75, and the expected yield is 325 or more board feet per acre per year for a stand at 60 years of age. The erosion hazard and equipment limitations are moderate; seedling mortality is slight to moderate; and plant competition and the windthrow hazard are slight.

Species to favor in existing stands are red oak, white oak, basswood, aspen, and white pine. Trees preferred for planting are white pine, red pine, and white spruce.

WOODLAND SUITABILITY GROUP 3w1

This group consists of somewhat poorly drained soils of the Conover, Locke, Metamora, and Minoa series. These soils have a medium-textured to coarse-textured surface layer and a moderately coarse textured and moderately fine textured subsoil. They range from medium to high in fertility and from moderate to high in available water capacity. They have a seasonal high water table. The slope range is 0 to 6 percent. These soils are moderately well suited to the production of hardwoods.

The site index for upland oaks is 65 to 75, and the expected yield is 200 to 275 board feet per acre per year for a stand at 80 years of age. Equipment limitations are moderate, and plant competition generally is severe. Other limitations are slight.

Species to favor in existing stands are white ash, red oak, white oak, basswood, and cottonwood. Trees preferred for planting are white spruce, white pine, northern white-cedar, and Norway spruce.

WOODLAND SUITABILITY GROUP 3w2

This group consists of somewhat poorly drained soils of the Brady, Thetford, and Wasepi series. These soils have a coarse textured or moderately coarse textured surface layer. Their subsoil generally is coarse textured to moderately fine textured, but it is coarse textured throughout in the Thetford soils. Fertility is low to medium. The soils have low available water capacity and a seasonal high water table. The slope range is 0 to 4 percent. These soils are moderately well suited to the production of hardwoods.

The site index for aspen is 55 to 65, and the expected yield is 125 to 200 board feet per acre per year for a stand of trees at 50 years of age. Equipment limitations and plant competition are moderate. Other limitations are slight.

Species to favor in existing stands are white ash, red maple, silver maple, aspen and swamp white oak. Trees preferred for planting are white spruce, Norway spruce, northern white-cedar and white pine.

WOODLAND SUITABILITY GROUP 3w3

This group consists of poorly drained soils of the Brookston, Pewamo, Sebewa, and Washtenaw series. These soils have a medium-textured surface layer, except for the Pewamo soil, which has a moderately fine textured surface layer. They have dominantly fine textured subsoil. These soils are highly fertile, and most of them have high available water capacity. They have a seasonal high water table. The slope range is 0 to 2 percent. These soils are moderately well suited to the production of hardwoods.

The site index for lowland hardwoods is 65 to 75, and the expected yield is 200 to 275 board feet per acre per year for a stand of trees at 70 years of age. The erosion hazard is slight on these soils. Equipment limitations and seedling mortality are severe, as is competition from other plants. The windthrow hazard is moderate.

Species to favor in existing stands are red maple, silver maple, basswood, pin oak, bur oak, white ash, and swamp white oak. In undrained areas, natural regeneration is better than planting on these soils. In drained areas, trees preferred for planting are white spruce, Norway spruce, white pine, and northern white-cedar.

WOODLAND SUITABILITY GROUP 4w3

This group consists of poorly drained or very poorly drained soils of the Barry, Berville, Breckenridge, Colwood, Gilford, and Lamson series. These soils have a medium-textured to moderately coarse textured surface layer and a moderately coarse textured to moderately fine textured subsoil. They have medium to high fertility and generally moderate to high available water capacity. These soils are poorly suited to the production of hardwoods.

The site index for lowland hardwoods is 55 to 65, and the expected yield is 125 to 200 board feet per acre per year for a stand at 80 years of age. The erosion hazard is slight. Equipment limitations, seedling mortality, and plant competition are all severe. The hazard of windthrow is moderate.

Species to favor in existing stands are white ash, red maple, silver maple, basswood, aspen, pin oak, and swamp white oak. Planting trees on these soils is not recommended unless drainage is improved. In drained areas, trees preferred for planting are white spruce, Norway spruce, white pine, and northern white-cedar.

WOODLAND SUITABILITY GROUP –w1

This group consists of very poorly drained, organic soils of the Carlisle, Edwards, Houghton, Linwood, Rifle, Tawas, and Warners series. In the Carlisle, Houghton, and Rifle soils, the organic matter is more than 40 inches thick. Edwards soils are underlain by marl at a depth

of 12 to 40 inches, and Warners soils at a depth of less than 12 inches. At a depth of 12 to 40 inches, Linwood soils are underlain by medium-textured to coarse-textured material and Tawas soils by coarse-textured material. All the soils have low fertility, and most of them have high to very high available water capacity. The water table is at or near the surface most of the year. The slope is less than 2 percent. Rifle soils are medium acid to extremely acid.

Timber production on the soils in this group is extremely variable. No data are available on potential productivity. The erosion hazard is only slight, but all other limitations are severe.

Species to favor in existing stands are red maple and aspen. Trees preferred for the planting in windbreaks only are Austrian pine, white pine, and Scotch pine.

Wildlife [4]

In table 3 the soils are rated according to their suitability for elements of wildlife habitat and, based on these ratings, their suitability for different kinds of wildlife. Borrow pits, Gravel pits, and Made land are not rated in table 3. These land types are so variable that an onsite investigation is needed.

A rating of *well suited* means the soil is relatively free of limitations or that the limitations are easily overcome. *Suited* means that the limitations need to be recognized but can be overcome by good management and careful design. *Poorly suited* means that limitations are severe enough to make the use of the soil questionable for wildlife habitat. *Not suited* means that extreme measures are needed to overcome the limitations and that usage generally is not practical. The elements of wildlife habitat are discussed in the following paragraphs.

Grain and seed crops include corn, wheat, oats, rye, soybeans, sorghum, buckwheat, field beans, millet, and sunflower.

Grasses and legumes are plants that wildlife commonly use for forage. These plants include alfalfa, clovers, bromegrass, sudangrass, timothy, orchardgrass, and reed canarygrass.

Wild herbaceous upland plants are native annual or other herbaceous plants that commonly grow in upland areas. Examples of these plants are strawberries, dandelion, goldenrod, mullin, burdock, milkweed, lambsquarters, and wild grasses.

Hardwood woody plants are hardwood trees and shrubs that produce vigorous growth and heavy crops of fruit or seed. They either grow naturally or are planted. Examples are maple, birch, oak, poplar, dogwood, wild cherry (choke), thornapple, raspberry, wild grape, sumac, multiflora rose, autumn-olive, blackberry, viburnums (cranberry, nannyberry, arrowwood, wildraisin), hickory, walnut, butternut, shadbush (juneberry), and Michigan holly.

Coniferous woody plants are native or planted coniferous trees and shrubs. Examples are white, Scotch, red, and Austrian pines; white and Norway spruces; and eastern redcedar.

Wetland food and cover plants are plants that commonly grow in wetland areas and provide food and cover for waterfowl and furbearing animals. Examples are cattail, sedge, arrowhead, bulrush, smartweed, burreed, pondweed, water plantain, and some microscopic forms.

Shallow water developments are impoundments in which shallow water can be maintained at a desirable level. Examples are level ditches and shallow dugouts.

Excavated ponds are ponds of the excavated or dugout type. Migrating waterfowl are especially attracted to such ponds. These must not depend on runoff from surrounding areas, though they may be benefited by such runoff if it is not excessive and does not cause too much silting in.

The suitability ratings in table 3 under "Kinds of wildlife" apply to broad kinds of wildlife and are based on elements of the habitat considered important to each kind. Following are discussions of the kinds of wildlife.

Openland wildlife consists of birds and mammals that normally frequent cropland, pasture, meadow, and areas overgrown with grasses, herbs, and shrubs (fig. 7). Examples are quail, ring-necked pheasant, meadowlark, field sparrow, hawk, skunk, weasel, fox, cottontail rabbit, woodchuck, field mice, and songbirds.

Woodland wildlife consists of birds and mammals that normally frequent wooded areas of hardwood trees, coniferous trees, shrubs, or mixed stands of such plants. Examples are woodpecker, warbler, nuthatch, owl, squirrel, raccoon, weasel, whitetailed deer, and opossum.

Wetland wildlife consists of birds and mammals that normally frequent wet areas such as ponds, marshes, and swamps. Examples are ducks, geese, heron, killdeer, bittern, and muskrat.

The ratings for kinds of wildlife indicate in a general way the places where habitats can be managed most practically and with satisfactory prospects of success for wildlife members of the group. The ratings also provide an indication of the level of habitat management necessary for wildlife in a given group. A rating of *poorly suited*, for example, indicates that, though the habitat may be productive, a high level of management is required.

Figure 7.—Multiflora rose hedge and corn stubble provide wildlife cover on a Metea loamy sand in the foreground and a Conover loam in the background.

[4] By CHARLES M. SMITH, biologist, Soil Conservation Service.

TABLE 3.—*Suitability of soils for elements*

Soil series and map symbols	Elements of wildlife habitat				
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants
Alluvial land: Ad	Suited	Suited	Well suited	Suited	Poorly suited
Arkport: ApA, ApB, ApC	Suited	Well suited	Well suited	Well suited	Suited
Barry: Ba	Not suited	Poorly suited	Poorly suited	Well suited	Well suited
Berville: Be	Not suited	Poorly suited	Poorly suited	Well suited	Well suited
Borrow pits: Bp. Not rated because onsite investigation required.					
Boyer:					
BrA, BrB, BrC, BtA, BtB, BtC	Suited	Well suited	Well suited	Suited	Suited
BtD, BtE	Poorly suited	Suited	Well suited	Suited	Suited
BtF	Not suited	Poorly suited	Well suited	Suited	Suited
BsA, BsB	Well suited	Well suited	Well suited	Well suited	Poorly suited
Ratings are for both Boyer and Oshtemo soils in mapping units BtA, BtB, BtC, BtD, BtE, and BtF.					
Brady: BuA	Suited	Suited	Well suited	Suited	Poorly suited
Breckenridge: Bv	Not suited	Poorly suited	Poorly suited	Well suited	Suited
Bronson: BwA	Suited	Well suited	Well suited	Well suited	Suited
Brookston: By	Not suited	Poorly suited	Poorly suited	Well suited	Well suited
Carlisle: Cc	Not suited	Not suited	Not suited	Not suited	Poorly suited
Colwood: Cr	Not suited	Poorly suited	Suited	Well suited	Well suited
Conover: CvA, CvB, CxA. For Miami part of CxA, see Miami series.	Suited	Suited	Well suited	Well suited	Suited
Edwards: Ed	Not suited	Poorly suited	Not suited	Not suited	Poorly suited
Fox:					
FoA, FoB, FoC, FrB, FrC	Suited	Well suited	Well suited	Well suited	Poorly suited
FrD, FrE	Poorly suited	Suited	Well suited	Well suited	Poorly suited
FrF	Not suited	Poorly suited	Well suited	Well suited	Poorly suited
For Boyer part of FrB, FrC, FrD, FrE, and FrF, see units having similar slopes under Boyer series.					
Gilford: Gd	Not suited	Suited	Suited	Suited	Suited
Gravel pits: Gr. Individual sites require onsite investigation.					
Hillsdale:					
HdB, HlB, HmB	Well suited	Well suited	Well suited	Well suited	Poorly suited
HdC, HlC, HlD, HmC	Suited	Well suited	Well suited	Well suited	Poorly suited
HlE	Poorly suited	Suited	Well suited	Well suited	Poorly suited
For Miami part of HmB and HmC, see units having similar slopes under the Miami series.					
Houghton: Ho	Not suited	Not suited	Not suited	Not suited	Poorly suited
Lake beaches: La	Not suited	Not suited	Not suited	Not suited	Not suited
Lamson: Lc	Not suited	Poorly suited	Poorly suited	Well suited	Well suited
Linwood: Lm	Not suited	Not suited	Not suited	Not suited	Poorly suited

of wildlife habitat and kinds of wildlife

Elements of wildlife habitat—Continued			Kinds of wildlife		
Wetland food and cover plants	Shallow water developments	Excavated ponds	Openland	Woodland	Wetland
Suited	Suited	Suited	Well suited	Suited	Suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Suited	Suited	Suited	Well suited	Suited	Suited.
Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Suited	Well suited	Well suited	Not suited	Poorly suited	Well suited.
Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Well suited	Well suited	Poorly suited	Poorly suited	Well suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Suited	Well suited	Well suited	Not suited	Poorly suited	Well suited.
Not suited	Not suited	Not suited	Not suited	Not suited	Not suited.
Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Not suited	Well suited	Well suited	Not suited	Poorly suited	Well suited.

TABLE 3.—*Suitability of soils for elements*

Soil series and map symbols	Elements of wildlife habitat				
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants	Coniferous woody plants
Locke: LoB	Suited	Suited	Well suited	Well suited	Poorly suited
Made land: Md. Individual sites require onsite investigation.					
Metamora: MlB	Suited	Suited	Well suited	Well suited	Suited
Metea: MnA, MnB, MnC	Suited	Suited	Suited	Well suited	Poorly suited
Miami:					
MoA, MoB, MrB	Well suited	Well suited	Well suited	Well suited	Poorly suited
For Conover part of MrB, see Conover series.					
MoC	Suited	Well suited	Well suited	Well suited	Poorly suited
MoD, MoE	Poorly suited	Suited	Well suited	Well suited	Poorly suited
MoF	Not suited	Poorly suited	Well suited	Well suited	Poorly suited
Minoa: MwB	Suited	Suited	Well suited	Well suited	Suited
For Thetford part, see the Thetford series.					
Oakville: OaB, OkB	Not suited	Poorly suited	Poorly suited	Poorly suited	Well suited
Oshtemo. Mapped only in complexes with Boyer soils. For ratings, see Boyer series.					
Ottokee: OlA, OlB	Not suited	Poorly suited	Poorly suited	Poorly suited	Well suited
Owosso:					
For Miami part of OmA, OmB, OmC, and OmD, see units having similar slopes under the Miami series.					
OmA, OmB	Well suited	Well suited	Well suited	Well suited	Poorly suited
OmC	Suited	Well suited	Well suited	Well suited	Poorly suited
OmD	Poorly suited	Suited	Well suited	Well suited	Poorly suited
Pewamo: Pc	Not suited	Poorly suited	Poorly suited	Well suited	Well suited
Rifle: Rf	Not suited	Not suited	Not suited	Not suited	Not suited
Sebewa: Se	Not suited	Poorly suited	Poorly suited	Well suited	Well suited
Spinks:					
SvB, SvC	Suited	Well suited	Well suited	Well suited	Suited
SvD, SvE	Poorly suited	Suited	Well suited	Well suited	Suited
SvF	Not suited	Poorly suited	Well suited	Well suited	Suited
For Oakville part of these units, see the Oakville series.					
Tawas: Tm	Not suited	Poorly suited	Not suited	Not suited	Poorly suited
Thetford. Mapped only in a complex with Minoa soils.	Suited	Suited	Well suited	Suited	Poorly suited
Warners: Wc	Not suited	Poorly suited	Not suited	Not suited	Not suited
Wasepi: WeA	Suited	Suited	Well suited	Well suited	Suited
Washtenaw: Wh	Not suited	Poorly suited	Poorly suited	Well suited	Well suited

of wildlife habitat and kinds of wildlife—Continued

Elements of wildlife habitat—Continued			Kinds of wildlife		
Wetland food and cover plants	Shallow water developments	Excavated ponds	Openland	Woodland	Wetland
Suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Suited	Suited	Well suited	Suited	Suited.
Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Suited	Suited	Suited	Well suited	Suited	Suited.
Not suited	Not suited	Not suited	Poorly suited	Poorly suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Poorly suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Not suited	Well suited	Well suited	Not suited	Not suited	Well siuted.
Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Not suited	Not suited	Not suited	Poorly suited	Suited	Not suited.
Suited	Well suited	Well suited	Not suited	Not suited	Well suited.
Suited	Suited	Suited	Well suited	Suited	Suited.
Not suited	Well suited	Well suited	Not suited	Poorly suited	Well suited.
Suited	Suited	Suited	Well suited	Suited	Suited.
Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.

Present land use and existing vegetation were not considered when the soils were rated. These factors, as well as the degree of artificial drainage, are subject to change. The ability of wildlife to move from place to place also is not considered in the rating. This is because the rating applies to habitats and not specifically to wildlife species.

The soil areas outlined on the soil maps are rated without regard to the adjoining soils. The size, shape, or location of the outlined soil area does not affect the rating.

Engineering Uses of the Soils [5]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for storing water, structures for controlling erosion, drainage systems, and systems for disposing of sewage. Among the soil properties most important to engineers are permeability, sheer strength, compaction characteristics, drainage, shrink-swell characteristics, grain size, plasticity, and reaction. Also important are depth to water table, flooding hazard, depth to bedrock, and relief.

The information in this section can be used to—

1. Make studies of soil and land use that aid in selecting and developing sites for industries, businesses, residences, and recreational facilities.
2. Make estimates of engineering properties for use in planning agricultural drainage structures, dams, and other structures for conserving soil and water; in locating suitable routes for underground conduits and cables; and in locating sites for sewage disposal fields.
3. Make preliminary evaluations of soil conditions that will aid in selecting locations for highways, airports, pipelines, and sewage disposal fields, and in planning detailed surveys of the soils at the selected locations.
4. Locate probable sources of sand, gravel, and other material for use in construction.
5. Correlate pavement performance with the soil mapping units and thus develop information that will be useful in designing and maintaining the pavements.
6. Supplement information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
7. Determine suitability of soils for movement of vehicles and construction equipment.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

It should be emphasized that the interpretations made in this soil survey are not a substitute for the sampling and testing needed at a site chosen for a specific engineering work that involves heavy loads or at a site where excavations are to be deeper than the depths of the layers here reported. The estimates reported are generally to a depth of about 5 feet and normally do not apply to greater depths. Nevertheless, by using this survey, an engineer can select and concentrate on those soil units most important to this proposed kind of construction, and in this manner reduce the number of soil samples taken for laboratory testing and complete an adequate soil investigation at minimum cost.

The mapping units shown on the maps in this survey may include small areas of different soil materials. These inclusions may be as much as 2 acres in size. They are not significant to the farming in the area but may be important in engineering planning.

Information of value in planning engineering work is given throughout the text, particularly in the sections "Descriptions of the Soils" and "Formation and Classification of the Soils."

Some of the terms used by the scientist may be unfamiliar to the engineer, and some words—for example, soil, clay, silt, and sand—may have special meanings in soil science. These and other special terms used in the soil survey are defined in the Glossary at the back of this survey. Most of the information about engineering is given in tables 4, 5, and 6.

Engineering classification systems

Agricultural scientists of the U.S. Department of Agriculture classify soils according to texture. In some ways this system of naming textural classes is comparable to the systems most commonly used by engineers for classifying soils; that is, the system of the American Association of State Highway Officials (AASHO) and the Unified system.

Most highway engineers classify soil material in accordance with the system approved by the American Association of State Highway Officials (*1*). In this system soil materials are classified in seven principal groups. The groups range from A-1 (gravelly soils having high bearing capacity, the best soils for subgrade) to A-7 (clayey soils having low strength when wet, the poorest soils for subgrade).

Some engineers prefer to use the Unified soil classification system (*8*). In this system soil materials are identified according to their texture, plasticity, and performance as construction material. Soil materials are identified as coarse grained (GW, GP, GM, GC, SW, SP, SM, and SC), fine grained (ML, CL, OL, MH, CH, and OH), and highly organic (Pt).

Soil properties significant in engineering

In table 4, the soil series and the symbols for most mapping units are listed and estimates of properties significant in engineering are given. The estimated properties are those of the representative soil. Where test data are available, that information was used. Where tests were not performed, the estimates shown are based on comparisons of the soils in Livingston County with similar soils tested in other counties.

Depth to seasonal high water table is the maximum height to which the water table rises during the year. The estimates are for soil material that has not been artificially drained. In general, the information in the table applies to a depth of 5 feet or less. Depth from surface normally is given only for the major horizons.

[5] KEITH I. BAKEMAN, civil engineer, Soil Conservation Service, assisted in preparing this section.

Other horizons are listed if they have engineering properties significantly different from adjacent horizons.

The estimated classification according to the textural classification of the U.S. Department of Agriculture and according to the AASHO and Unified classification systems is given for each important layer. The figures showing the percentages of material passing through sieves Nos. 4, 10, and 200 are rounded off to the nearest 5 percent. The percentage passing the No. 200 sieve approximates the combined amount of silt and clay in the soil. The percentage of coarse fragments larger than 3 inches in diameter is given in footnotes at the end of table 4.

In the column "Permeability" are estimates of the rate at which water moves downward through undisturbed soil material. The estimates are based mainly on texture, structure, and consistence of the soils.

Available water capacity, expressed in inches per inch of soil depth, is defined in the Glossary. Shrink-swell potential refers to the change in volume of the soil that results from a change in moisture content. The estimates are based mainly on the amount and kind of clay in the soil.

Engineering interpretations

Engineering interpretations are given in tables 5 and 6. The data in these tables apply to the representative profile for the soil series in the section "Descriptions of the Soils."

Table 5 gives the suitability of the soils as a source of topsoil, sand, gravel, and road fill, and lists features that affect the use of the soils in highway locations, foundations for low buildings, and winter grading. Also given in table 5 are limitations for septic tank disposal fields and ratings for the corrosive potential for conduits.

The ratings for suitability as a source of topsoil are based largely on texture and content of organic matter. Topsoil material, preferably material rich in organic matter, is used to topdress back slopes, embankments, lawns, gardens, and the like. Unless otherwise indicated, only the surface layer is considered in making these ratings.

Ratings of suitability of the soil as a source of sand and gravel apply only to material within a depth of 5 feet. Some soils that are rated "Not suitable" may have sand and gravel at a depth of more than 5 feet. In some of the soils, sand and gravel are at a depth of less than 5 feet and extend to a depth greater than 5 feet. Where suitability is questionable, the availability of the sand and gravel can be determined by digging test pits. Soils of the Boyer, Brady, Bronson, Fox, Gilford, Sebewa, and Wasepi series have fair to good potential as sources of gravel.

Ratings of the suitability of the soil as a source of road fill are based on performance of soil material used as borrow for subgrade. Both the subsoil and substratum are rated if they have contrasting characteristics. The most suitable material is sand with enough fines for binding; the least suitable is clay.

Also listed in table 5 are soil features affecting locations for highways (fig. 8). The features considered are those that affect the overall performance of the soil, such as a high water table or steep slopes. The entire soil profile, undisturbed and without artificial drainage, is evaluated. Good materials for road subbase are well distributed throughout the county in the sandy and gravelly soils. Additional information can be obtained from the State Highway Department of Michigan, which has rated the major soil series in the State for their suitability for highway construction. This information is in the "Field Manual of Soil Engineering" (*2*).

***Figure 8.*—Soil survey information helps locate sites suitable for highways.**

The soils are also rated in table 5 as to their suitability for foundations for buildings that are no more than three stories high. The suitability of the soils as a base for low buildings depends mainly on characteristics of the substratum, which generally provides the base for foundations. Ratings are therefore for the substratum. Important factors considered in determining the suitability of the soils as foundations for low buildings are susceptibility to frost heaving, depth to water table, compressibility, and shrink-swell potential. Engineers and others should not apply specific values to the estimates given.

Among the soil features that affect winter grading are those that, in winter, affect the crossing of areas of soil and the handling of soil material with ordinary construction equipment. Important factors considered are texture of the soil material, natural content of water, and depth to water table.

Limitations of the soils for use as disposal fields for septic tanks as well as features that affect their use for this purpose are also shown in table 5. Some of the limiting factors are permeability, depth to water table, and relief. Soils that have somewhat poor to poor drainage, a seasonal high water table, or slow permeability are poor sites. A sewage disposal system does not function properly in such soils. A percolation rate of 60 minutes per inch or less is desirable for a septic disposal field. This is equivalent to a permeability of 1 inch per hour. Permeability rates for the soils in Livingston County are given in table 4.

The soils are also rated in table 5 according to the degree that they encourage the corrosion of conduits laid in them. Ratings are given for uncoated steel conduits and concrete conduits. The texture and natural drainage of a soil affect this potential through their influence on

TABLE 4.—*Estimated*

[Not listed in this table are Alluvial land (Ad), Borrow pits (Bp), Gravel pits (Gr), Lake beaches (La), and Made land (Md). These land made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this

Soil series and map symbols	Depth to seasonal high water table	Depth from surface [1]	Classification: USDA texture
	Feet	*Inches*	
Arkport: ApA, ApB, ApC	4 or more.	0–10	Fine sandy loam
		10–42	Stratified fine sandy loam, loamy fine sand, silt, and silt loam.
		42–60	Stratified fine sandy loam and silt
Barry: Ba	Less than 1.	0–14	Sandy loam [3]
		14–34	Loam and light sandy clay loam
		34–60	Sandy loam and loamy fine sand
Berville: Be	Less than 1.	0–10	Loam
		10–32	Light sandy clay loam
		32–60	Loam
*Boyer:			
BrA, BrB, BrC, BtA, BtB, BtC, BtD, BtE, BtF. For the Oshtemo part of BtA, BtB, BtC, BtD, BtE, and BtF, see the Oshtemo series.	4 or more.	0–16	Loamy sand [3]
		16–36	Gravelly sandy loam or gravelly light sandy clay loam.
		36–60	Gravelly sand
BsA, BsB	3 or more.	0–16	Loamy sand
		16–36	Gravelly sandy loam or gravelly light sandy clay loam.
		36–45	Gravelly sand
		45–60	Stratified silt and very fine sand
Brady: BuA	1 to 2.	0–25	Loamy sand and sand
		25–51	Loamy sand, sandy loam, and sandy clay loam.
		51–60	Gravelly sand
Breckenridge: Bv	Less than 1.	0–11	Loamy sand
		11–42	Sandy loam and sand
		42–60	Loam
Bronson: BwA	2 to 3.	0–28	Loamy sand
		28–42	Light sandy loam
		42–60	Gravelly sand
Brookston: By	Less than 1.	0–10	Loam
		10–26	Clay loam
		26–60	Loam and light clay loam
Carlisle: Cc	At surface.	0–48	Muck
Colwood: Cr	Less than 1.	0–13	Fine sandy loam
		13–26	Loam or silt loam
		26–60	Silty clay loam and silt loam
*Conover: CvA, CvB, CxA. For the Miami part of CxA, see the Miami series.	1 to 2.	0–13	Loam
		13–34	Clay loam
		34–60	Loam and light clay loam
Edwards: Ed	At surface.	0–19	Muck
		19–48	Marl
*Fox: FoA, FoB, FoC, FrB, FrC, FrD, FrE, FrF. For the Boyer part of FrB, FrC, FrD, FrE, and FrF, see the Boyer series.	4 or more.	0–13	Sandy loam [3]
		13–36	Sandy clay loam and gravelly loam
		36–60	Gravelly sand
Gilford: Gd	Less than 1.	0–24	Sandy loam
		24–36	Sandy loam and sandy clay loam
		36–60	Gravelly sand

See footnotes at end of table.

properties

types are variable and require onsite investigation. An asterisk in the first column indicates that at least one mapping unit in this series is reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 200 (0.074 mm)				
					Inches per hour	*Inches per inch of soil*	*pH*	
SM	A-2	100	100	20–35	2. 0–6. 3	0. 16	6. 1–7. 3	Low.
SM or ML	A-2 or A-4	95–100	95–100	20–55	0. 63–2. 0	. 14	6. 6–7. 3	Low.
SM and ML	A-2 and A-4	95–100	95–100	20–55	2. 0–6. 3	. 14	[2] 7. 4–7. 8	Low.
SM	A-2 or A-4	95–100	90–100	25–45	2. 0–6. 3	. 14	7. 4–7. 8	Low.
ML-CL or SC	A-4 or A-6	95–100	90–100	35–65	0. 63–2. 0	. 18	7. 4–7. 8	Moderate.
SM	A-2 or A-4	85–95	80–95	15–45	2. 0–6. 3	. 10	[2] 7. 4–8. 0	Low.
ML-CL	A-4	100	90–100	60–70	0. 63–2. 0	. 18	7. 4–7. 8	Low.
SM or SC	A-2 or A-6	95–100	60–90	30–45	0. 63–2. 0	. 18	7. 4–7. 8	Low.
ML or CL	A-4 or A-6	95–100	85–100	60–80	0. 2–0. 63	. 16	[2] 7. 4–8. 0	Low to moderate.
SM	A-2	95–100	70–100	15–30	2. 0–6. 3	. 10	5. 1–6. 0	Low.
SM or SC	A-2, A-4, or A-6	95–100	65–80	30–45	2. 0–6. 3	. 10	5. 1–5. 5	Low.
SP-SM or SP	A-3 or A-1	55–80	50–70	0–10	6. 3–20. 0	. 02	7. 4–8. 0	Low.
SM	A-2	95–100	85–100	15–30	2. 0–6. 3	. 10	5. 1–6. 0	Low.
SM or SC	A-2, A-4, or A-6	85–95	65–80	30–45	2. 0–6. 3	. 10	5. 1–5. 5	Low.
SP or SP-SM	A-3 or A-1	55–80	50–70	0–10	6. 3–20. 0	. 02	[2] 7. 4–8. 0	Low.
ML and SM	A-4	100	95–100	40–70	0. 63–2. 0	. 13	[2] 7. 4–8. 0	Low.
SM	A-2	95–100	85–100	15–30	2. 0–6. 3	. 10	5. 6–6. 0	Low.
SM or SC	A-2, A-4, or A-6	95–100	80–100	30–50	2. 0–6. 3	. 10	5. 6–7. 3	Low.
SP-SM or SP	A-1 or A-3	55–80	50–70	0–10	6. 3–20. 0	. 02	[2] 7. 4–8. 0	Low.
SM	A-2	95–100	85–100	15–30	2. 0–6. 3	. 10	6. 6–7. 3	Low.
SM	A-2 or A-4	95–100	90–100	25–50	2. 0–6. 3	. 12	6. 6–7. 8	Low.
ML or CL	A-4 or A-6	100	90–100	60–70	0. 2–0. 63	. 16	[2] 7. 4–8. 0	Low to moderate.
SM	A-2	95–100	85–100	15–30	2. 0–6. 3	. 10	5. 6–6. 0	Low.
SM	A-2 or A-4	95–100	90–100	25–40	2. 0–6. 3	. 10	6. 1–6. 5	Low.
SP-SM or SP	A-1 or A-3	55–80	50–70	0–10	6. 3–20. 0	. 02	[2] 7. 4–8. 0	Low.
ML-CL	A-4	100	85–100	60–70	0. 63–2. 0	. 20	7. 4–7. 8	Low.
CL	A-6	95–100	85–100	65–80	0. 63–2. 0	. 18	7. 4–7. 8	Moderate.
ML-CL or CL	A-4 or A-6	95–100	85–100	60–80	0. 2–0. 63	. 18	[2] 7. 4–8. 0	Low to moderate.
Pt	----------	----------	----------	----------	2. 0–6. 3	. 25	6. 1–7. 3	Variable.
SM	A-2	100	100	15–35	2. 0–6. 3	. 14	6. 1–6. 5	Low.
ML-CL	A-4	100	100	60–70	0. 63–2. 0	. 18	6. 1–7. 8	Low.
ML and CL	A-4 and A-6	100	95–100	85–95	0. 63–2. 0	. 16	[2] 7. 4–8. 0	Low to moderate.
ML	A-4	100	85–100	60–70	0. 63–2. 0	. 18	6. 1–6. 5	Low.
CL	A-6	95–100	85–100	65–80	0. 63–2. 0	. 18	5. 6–6. 0	Moderate.
ML-CL or CL	A-4 or A-6	90–95	85–95	60–80	0. 2–0. 63	. 16	[2] 7. 4–8. 0	Low to moderate.
Pt	----------	----------	----------	----------	2. 0–6. 3	. 25	6. 6–7. 3	Variable.
----------	----------	----------	----------	----------	(4)	(4)	[5] 7. 8–8. 0	Variable.
SM	A-2 or A-4	95–100	85–100	25–45	2. 0–6. 3	. 14	6. 1–7. 3	Low.
SC or CL	A-6	95–100	75–80	35–60	0. 63–2. 0	. 18	5. 6–7. 3	Moderate.
GP or SP	A-1	40–80	35–70	0–5	6. 3–20. 0	. 02	[2] 7. 4–8. 0	Low.
SM	A-2	95–100	85–100	15–30	2. 0–6. 3	. 14	5. 6–6. 5	Low.
SM or SC	A-2, A-4, or A-6	95–100	90–100	30–45	2. 0–6. 3	. 14	5. 6–6. 0	Low.
SP-SM or SP	A-3 or A-1	55–80	50–70	0–10	6. 3–20. 0	. 02	[2] 7. 4–8. 0	Low.

TABLE 4.—*Estimated*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface [1]	Classification: USDA texture
	Feet	*Inches*	
*Hillsdale: HdB, HdC, HlB, HlC, HlD, HlE, HmB, HmC. For the Miami part of HmB and HmC, see the Miami series.	4 or more.	0–21	Sandy loam [3]
		21–38	Sandy clay loam
		38–65	Sandy loam
		65–70	Sandy loam
Houghton: Ho	At surface.	0–48	Muck
Lamson: Lc	Less than 1.	0–12	Fine sandy loam
		12–25	Very fine sandy loam and silt
		25–38	Stratified very fine sand and silt loam
		38–60	Light silty clay loam and heavy silt loam
Linwood: Lm	At surface.	0–31	Muck
		31–60	Stratified silt loam, fine sandy loam, and very fine sand.
Locke: LoB	1 to 2.	0–16	Sandy loam
		16–26	Sandy clay loam
		26–60	Sandy loam
Metamora: MlB	1 to 2.	0–21	Sandy loam
		21–35	Sandy clay loam
		35–60	Clay loam
Metea: MnA, MnB, MnC	3 or more.	0–29	Loamy sand
		29–48	Clay loam
		48–60	Loam
*Miami: MoA, MoB, MoC, MoD, MoE, MoF, MrB. For the Conover part of MrB, see the Conover series.	4 or more.	0–12	Loam [3]
		12–31	Clay loam
		31–60	Loam
*Minoa: MwB. For the Thetford part, see the Thetford series.	1 to 2.	0–10	Loamy fine sand
		10–29	Fine sandy loam
		29–60	Stratified fine sand and silt loam
Oakville:			
OaB	4 or more.	0–60	Fine sand
OkB	3 or more.	0–53	Fine sand
		53–60	Loam
Oshtemo. Mapped only with the Boyer series.	4 or more.	0–39	Loamy sand and sand [3]
		39–50	Sandy loam and sandy clay loam
		50–60	Gravelly sand
Ottokee: OlA, OlB	2 to 3.	0–17	Loamy sand
		17–49	Layers of fine sand, loamy sand, and sandy loam.
		49–60	Sand
*Owosso: OmA, OmB, OmC, OmD. For the Miami part, see the Miami series.	4 or more.	0–34	Sandy loam [3]
		34–43	Clay loam
		43–60	Loam
Pewamo: Pc	Less than 1.	0–10	Clay loam
		10–36	Silty clay loam
		36–60	Silty clay loam
Rifle: Rf	At surface.	0–13	Muck
		13–60	Mucky peat
Sebewa: Se	Less than 1.	0–10	Loam
		10–21	Light sandy loam
		21–33	Sandy clay loam
		33–60	Gravelly sand

See footnotes at end of table.

properties—Continued

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 200 (0.074 mm)				
					Inches per hour	*Inches per inch of soil*	*pH*	
SM	A-2 or A-4	95-100	85-100	25-45	2.0-6.3	.12	5.6-7.3	Low.
SC	A-6	95-100	85-100	35-50	0.63-2.0	.16	5.1-6.5	Low to moderate.
SM	A-2 or A-4	80-95	75-95	25-45	0.63-2.0	.10	5.1-6.5	Low.
SM	A-2 or A-4	80-95	75-95	25-45	0.63-2.0	.10	[2] 6.1-8.0	Low.
Pt	----------	----------	----------	----------	2.0-6.3	.25	5.1-7.3	Variable.
SM	A-2	95-100	95-100	15-35	2.0-6.3	.14	7.4-7.8	Low.
ML	A-4	95-100	95-100	50-65	2.0-6.3	.14	[2] 7.4-8.0	Low.
SM or ML	A-2 or A-4	95-100	95-100	25-55	0.63-2.0	.12	[2] 7.4-8.0	Low.
ML or CL	A-4 or A-6	95-100	90-100	70-85	0.63-2.0	.16	[2] 7.4-8.0	Low to moderate.
Pt	----------	----------	----------	----------	2.0-6.3	.25	5.6-7.3	Variable.
ML or ML-CL	A-4	95-100	90-100	50-70	0.2-0.63	.16	[2] 7.4-8.0	Low to moderate.
SM	A-2 or A-4	95-100	85-100	24-45	2.0-6.3	.12	5.6-7.3	Low.
SC	A-6	95-100	90-100	35-50	0.63-2.0	.17	5.6-7.3	Low to moderate.
SM	A-2 or A-4	80-95	75-95	20-45	2.0-6.3	.10	[2] 5.6-8.0	Low.
SM	A-2	95-100	85-100	15-25	2.0-6.3	.10	5.6-7.3	Low.
SC	A-6	95-100	85-95	35-50	0.63-2.0	.16	7.4-7.8	Low.
CL	A-6	90-95	85-95	60-80	0.2-0.63	.16	[2] 7.4-8.0	Moderate.
SM	A-2	95-100	95-100	15-30	6.3-20.0	.10	5.1-7.3	Low.
CL	A-6	95-100	90-100	60-80	0.63-2.0	.16	5.1-7.3	Moderate.
ML or CL	A-4 or A-6	85-95	80-90	60-70	0.63-2.0	.14	[2] 7.4-8.0	Low to moderate.
ML-CL	A-4	100	90-100	60-70	0.63-2.0	.16	5.1-7.8	Low.
CL	A-6	95-100	90-100	65-80	0.63-2.0	.18	5.1-7.8	Moderate.
ML or CL	A-4 or A-6	90-95	85-95	55-70	0.63-2.0	.16	[2] 7.4-8.0	Low to moderate.
SM	A-2	100	100	15-35	2.0-6.3	.10	6.1-7.3	Low.
SM	A-2 or A-4	95-100	95-100	20-45	2.0-6.3	.12	6.1-7.3	Low.
SM or ML	A-2 or A-4	95-100	95-100	25-55	0.63-2.0	.14	[2] 7.4-8.0	Low.
SP	A-3	100	95-100	0-5	6.3-20.0	.06	5.6-7.3	Low.
SP	A-3	100	95-100	0-5	6.3-20.0	.06	5.6-7.3	Low.
ML	A-4	85-95	80-95	60-70	0.63-2.0	.16	[2] 7.4-8.0	Low.
SM or SP-SM	A-2 or A-3	100	85-100	5-20	6.3-20.0	.08	5.6-7.3	Low.
SM or SC	A-2, A-4, or A-6	95-100	85-100	30-45	0.63-2.0	.12	5.6-7.3	Low.
SP-SM or SP	A-3 or A-1	55-80	50-70	0-10	6.3-20.0	.02	[2] 7.4-8.0	Low.
SP-SM or SM	A-2	100	100	10-20	6.3-20.0	.10	5.6-7.3	Low.
SM and SP-SM	A-2	100	100	10-25	6.3-20.0	.10	6.6-7.3	Low.
SP	A-3	100	100	0-5	6.3-20.0	.04	6.6-7.3	Low.
SM	A-2	95-100	85-100	15-25	2.0-6.3	.10	5.6-7.3	Low.
CL	A-6	95-100	85-100	70-85	0.2-0.63	.15	5.6-7.3	Moderate.
ML or CL	A-4 or A-6	85-95	80-90	60-70	0.2-0.63	.14	[2] 7.4-8.0	Low to moderate.
CL	A-6	100	95-100	60-80	0.63-2.0	.18	6.1-7.8	Moderate.
CL	A-7	100	95-100	70-90	0.2-0.63	.16	6.1-7.8	Moderate to high.
CL	A-6	100	95-100	70-90	0.2-0.63	.16	[2] 7.8-8.0	Moderate.
Pt	----------	----------	----------	----------	2.0-6.3	.25	Below 4.5	Variable.
Pt	----------	----------	----------	----------	2.0-6.3	.25	4.5-6.0	Variable.
ML	A-4	95-100	85-100	60-70	2.0-6.3	.20	6.6-7.3	Low.
SM	A-2	95-100	85-100	15-30	2.0-6.3	.14	6.6-7.3	Low.
SC	A-6	95-100	85-100	35-50	0.63-2.0	.18	6.6-7.3	Moderate.
GP or SP	A-1	40-80	35-70	0-5	6.3-20.0	.02	[2] 7.4-8.0	Low.

TABLE 4.—*Estimated*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface [1]	Classification: USDA texture
	Feet	*Inches*	
*Spinks: SvB, SvC, SvD, SvE, SvF. For the Oakville part, see the Oakville series.	4 or more.	0–28	Loamy sand
		28–60	Sand and loamy sand
		60–66	Sand
Tawas: Tm	At surface.	0–18	Muck
		18–60	Sand
Thetford. Mapped only with Minoa series.	1 to 2.	0–28	Loamy sand
		28–55	Loamy sand and light sandy loam
		55–60	Very fine sand
Warners: Wc	At surface.	0–12	Loam
		12–40	Marl
Wasepi: WeA	1 to 2.	0–14	Sandy loam
		14–23	Loam and sandy clay loam
		23–34	Loamy sand
		34–60	Gravelly sand
Washtenaw: Wh	Less than 1.	0–19	Silt loam
		19–50	Silt loam
		50–60	Loam

[1] The depths given are for the representative profiles given in the section "Descriptions of the Soils." Variations in the thickness and in the depth to a layer are common for most soils.

[2] Slightly effervescent.

TABLE 5.—*Engineering*

[Not listed in this table are Alluvial land (Ad), Borrow pits (Bp), Gravel pits (Gr), Lake beaches (La), and Made land (Md). These land made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this

Soil series and map symbols	Suitability as source of—: Topsoil	Sand	Gravel	Road fill
Arkport: ApA, ApB, ApC	Good: to depth of 10 to 16 inches; low organic-matter content.	Not suitable: stratified fine sand, sandy loam, silt, and loam.	Not suitable: stratified fine sand, sandy loam, silt, and loam.	Fair: low-shrink swell potential; slight compressibility; fair compaction; good stability.
Barry: Ba	Poor: to depth of 10 to 14 inches; loamy; high organic-matter content; high water table.	Not suitable: underlain by sandy loam.	Not suitable: underlain by sandy loam.	Poor: low shrink-swell potential; slight compressibility; fair compaction and stability; wetness hinders excavation.
Berville: Be	Poor: to depth of 6 to 12 inches; loamy; high organic-matter content; high water table.	Not suitable: loam underlying material.	Not suitable: loam underlying material.	Poor: low to moderate shrink-swell potential; slight to medium compressibility; fair compaction and stability; wetness hinders excavation.

properties—Continued

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 200 (0.074 mm)				
					Inches per hour	*Inches per inch of soil*	*pH*	
SP-SM or SM	A-2	100	85-100	10-20	6.3-20.0	.10	6.1-7.3	Low.
SP-SM	A-3	100	95-100	5-10	2.0-6.3	.08	6.1-7.3	Low.
SP	A-3	100	100	0-5	6.3-20.0	.04	6.6-7.8	Low.
Pt	----------	----------	----------	----------	2.0-6.3	.25	5.6-7.3	Variable.
SP-SM or SP	A-3	100	95-100	0-10	6.3-20.0	.07	6.6-7.8	Low.
SM	A-2	100	95-100	15-20	6.3-20.0	.10	6.1-7.3	Low.
SM and SP-SM	A-2	100	100	15-25	2.0-6.3	.10	6.1-7.3	Low.
SM	A-2 or A-4	100	95-100	35-50	6.3-20.0	.04	7.4-7.8	Low.
ML	A-4	95-100	95-100	55-65	0.63-2.0	.20	7.4-7.8	Low.
----------	----------	----------	----------	----------	[4]	[4]	[5] 7.8-8.0	Variable.
SM	A-2	95-100	85-100	15-30	2.0-6.3	.14	6.1-7.3	Low.
ML-CL or SC	A-4 or A-6	95-100	75-100	35-60	2.0-6.3	.16	6.6-7.3	Low.
SM	A-2	95-100	75-100	15-25	2.0-6.3	.06	6.6-7.8	Low.
SP-SM or SP	A-3	55-80	50-70	0-10	6.3-20.0	.04	[3] 7.4-8.0	Low.
ML-CL	A-4	100	95-100	70-90	0.63-2.0	.20	5.1-6.0	Low.
ML-CL	A-4	100	95-100	60-80	0.2-0.63	.16	6.1-6.5	Low.
ML-CL	A-4	95-100	95-100	60-80	0.2-0.63	.16	7.4-7.8	Low.

[3] Content of coarse fraction more than 3 inches in size is 1 to 5 percent in some areas.
[4] Variable.
[5] Violently effervescent.

interpretations

types are variable and require onsite investigation. An asterisk in the first column indicates that at least one mapping unit in this series is reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Soil features affecting—			Degree and kinds of limitation for septic tank disposal field	Corrosion potential for conduits of—	
Highway location	Foundations for low buildings	Winter grading		Uncoated steel	Concrete
Cuts and fills needed in some areas; well drained; moderate susceptibility to frost action; good stability.	Good stability; low shrink-swell potential; slight compressibility; well drained.	Loamy; good stability on thawing.	Slight: moderate permeability; possible pollution of shallow water supplies.	Low	Low.
Nearly level; high water table; moderate susceptibility to frost action; fair stability; wetness hinders construction.	Fair stability; low shrink-swell potential; slight compressibility; high water table.	Loamy; high water table; wetness hinders operations; fair stability on thawing; cobbly in a few areas.	Severe: moderate permeability; high water table; disposal field saturated during wet periods.	High	Low.
Nearly level; high water table; high susceptibility to frost action; poor stability; wetness hinders construction.	Fair stability; low to moderate shrink-swell potential; slight to medium compressibility; high water table.	Loamy; high water table; poor stability on thawing.	Severe: moderately slow permeability; high water table; disposal fields saturated during wet periods.	High	Low.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill
*Boyer: BrA, BrB, BrC, BtA, BtB, BtC, BtD, BtE, BtF. For the Oshtemo part of BtA, BtB, BtC, BtD, BtE, and BtF, see Oshtemo series.	Poor: to depth of 6 to 14 inches; sandy; low organic-matter content; gravelly on surface in some areas.	Good: sand and some fines and gravel.	Fair: generally more than 50 percent sand and some fines.	Good: low shrink-swell potential; slight compressibility; fair compaction and stability; gravelly sand is good subgrade material.
BsA, BsB	Poor: to depth of 8 to 12 inches; sandy; low organic-matter content; gravelly on surface in some areas.	Poor: thin layers of sandy material.	Poor: thin layers of gravelly material.	Good in upper 40 to 50 inches: low shrink-swell potential; slight compressibility; fair compaction and stability. Poor below depth of 50 inches: low shrink-swell potential; medium compressibility; fair compaction and stability; material flows when wet.
Brady: BuA	Poor: to depth of 6 to 8 inches; sandy; low content of organic matter; seasonal high water table.	Fair: sandy with some fines and gravel; seasonal high water table.	Fair: sandy material with 30 to 50 percent gravel; seasonal high water table.	Fair: low shrink-swell potential; slight compressibility; good compaction; fair stability.
Breckenridge: Bv	Poor: to depth of 8 to 11 inches; sandy; moderate organic-matter content; high water table.	Not suitable: loam underlying material.	Not suitable: loam underlying material.	Fair: low shrink-swell potential; medium compressibility: fair compaction and stability; wetness hinders construction.
Bronson: BwA	Poor: to depth of 8 to 11 inches; sandy; low organic-matter content.	Fair: sand and some fines and gravel.	Fair: generally more than 50 percent sand and some fines.	Good: low shrink-swell potential; slight compressibility; fair compaction and stability; generally sand material provides good subgrade material.
Brookston: By	Poor: to depth of 8 to 12 inches; loamy; high organic-matter content; high water table.	Not suitable: loam and clay loam underlying material.	Not suitable: underlain by loam and clay loam.	Poor: low to moderate shrink-swell potential; medium compressibility; fair compaction and stability; wetness hinders excavation.
Carlisle: Cc	Poor: organic soil erodible and oxidizes readily; high water table.	Not suitable: organic soil.	Not suitable: organic soil.	Not suitable: variable shrink-swell potential; high compressibility; poor compaction; very poor stability; wetness hinders excavation.
Colwood: Cr	Poor: to depth of 8 to 14 inches; loamy; high organic-matter content; high water table.	Not suitable: underlain by silty clay loam and silt loam.	Not suitable: underlain by silty clay loam and silt loam.	Poor: low to moderate shrink-swell potential; medium compressibility; poor compaction and stability; wetness hinders excavation; material flows when wet.

interpretations—Continued

Soil features affecting— Highway location	Soil features affecting— Foundations for low buildings	Soil features affecting— Winter grading	Degree and kinds of limitation for septic tank disposal field	Corrosion potential for conduits of— Uncoated steel	Corrosion potential for conduits of— Concrete
Cuts and fills needed in many places; well drained, low susceptibility to frost action; fair stability.	Fair stability; low shrink-swell potential; slight compressibility; well drained.	Sandy; low moisture content; good stability on thawing; cobbly in a few areas.	Slight on slopes of 0 to 12 percent: moderately rapid permeability; possible pollution of shallow water supplies. Moderate on slopes of 12 to 18 percent; installation and operation of disposal fields are difficult on slopes of more than 12 percent. Severe on slopes of 18 to 40 percent; too steep.	Low	Low.
Nearly level to gently sloping; well drained, low susceptibility to frost action; fair stability; material below depth of 50 inches has high susceptibility to frost action.	Fair stability; low shrink-swell potential; medium compressibility; well drained.	Sandy; low moisture content; good stability on thawing; cobbly in a few areas.	Moderate: moderately rapid permeability; possible pollution of of shallow water supplies; needs onsite investigation.	Moderate	Low.
Nearly level; seasonal high water table; low susceptibility to frost action; fair stability; seasonal wetness hinders construction.	Fair stability; low shrink-swell potential; slight compressibility; seasonal high water table.	Sandy; seasonal high water table; wetness hinders operations in some areas; good stability on thawing.	Moderate to severe: moderately rapid permeability; seasonal high water table; possible pollution of shallow water supplies; needs onsite investigation.	Moderate	Low.
Nearly level; high water table; moderate susceptibility to frost action; fair stability; wetness hinders construction.	Fair stability; low to moderate shrink-swell potential; medium compressibility; high water table.	Loamy: high water table; wetness hinders operations; fair stability on thawing.	Severe: moderately rapid permeability; high water table; disposal field saturated during wet periods.	High	Low.
Nearly level; moderately well drained; low susceptibility to frost action; fair stability.	Fair stability; low shrink-swell potential; slight compressibility; seasonal high water table.	Sandy; low moisture content; good stability on thawing.	Moderate: moderately rapid permeability; seasonal high water table; possible pollution of shallow water supplies.	Low	Low.
Nearly level; high water table; high susceptibility to frost action; fair stability; wetness hinders construction.	Fair stability; low to moderate shrink-swell potential; medium compressibility; high water table.	Loamy; high water table; wetness hinders operations; poor stability on thawing.	Severe: moderately slow permeability; high water table; disposal field saturated during wet periods.	High	Low.
Nearly level; high water table; high susceptibility to frost action; unstable organic soil; wetness hinders construction.	Very poor stability; variable shrink-swell potential; high compressibility; high water table.	Organic material; high water table; wetness hinders operations; very poor stability on thawing.	Severe: moderately rapid permeability; high water table; unstable organic material; disposal field saturated during wet periods.	High	Moderate.
Nearly level; high water table; high susceptibility to frost action; poor stability; wetness hinders construction.	Poor stability; low to moderate shrink-swell potential; medium compressibility; high water table.	Loamy; high water table; wetness hinders operations; poor stability on thawing.	Severe: moderate permeability; high water table; disposal field saturated during wet periods.	High	Low.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill
*Conover: CvA, CvB, CxA. For the Miami part of CxA, see the Miami series.	Good: to depth of 7 to 10 inches; loamy; medium organic-matter content; seasonal high water table.	Not suitable: underlain by loam and light clay loam.	Not suitable: underlain by loam and light clay loam.	Fair: low to moderate shrink-swell potential; medium compressibility; fair compaction and stability.
Edwards: Ed	Poor: organic soil erodible and oxidizes readily; high water table.	Not suitable: shallow organic soil over marl.	Not suitable: shallow organic soil over marl.	Not suitable: variable shrink-swell potential; high compressibility; poor compaction; very poor stability; wetness hinders excavation.
*Fox: FoA, FoB, FoC, FrB, FrC, FrD, FrE, FrF. For the Boyer part of FrB, FrC, FrD, FrE, and FrF, see the Boyer series.	Fair: to depth of 6 to 14 inches; loamy; low organic-matter content.	Good: gravelly sand.	Good: gravelly sand.	Good: low shrink-swell potential; slight compressibility; fair compaction and stability.
Gilford: Gd	Poor: to depth of 10 to 14 inches; loamy; high organic-matter content.	Fair: gravelly sand and some fines; high water table.	Fair: sandy material; 30 to 50 percent gravel; high water table.	Poor: low shrink-swell potential; slight compressibility; fair compaction and stability; wetness hinders excavation.
*Hillsdale: HdB, HdC, HlB, HlC, HlD, HlE, HmB, HmC. For the Miami part of HmB and HmC, see the Miami series.	Good: to depth of 8 to 16 inches; loamy; medium organic-matter content.	Not suitable: underlain by sandy loam.	Not suitable: underlain by sandy loam.	Fair: low to moderate shrink-swell potential; slight to medium compressibility; good to fair compaction; fair stability.
Houghton: Ho	Poor: organic soil erosive and oxidizes readily; high water table.	Not suitable: organic soil.	Not suitable: organic soil.	Not suitable: variable shrink-swell potential; high compressibility; poor compaction; very poor stability; wetness hinders excavation.
Lamson: Lc	Poor: to depth of 8 to 10 inches; loamy; high organic-matter content; high water table.	Not suitable: underlain by stratified silty clay loam and silt loam, very fine sand and silt.	Not suitable: underlain by stratified silty clay loam and silt loam, very fine sand and silt.	Poor: low shrink-swell potential; medium compressibility; poor compaction and stability; wetness hinders construction; material flows when wet.

interpretations—Continued

Soil features affecting—			Degree and kinds of limitation for septic tank disposal field	Corrosion potential for conduits of—	
Highway location	Foundations for low buildings	Winter grading		Uncoated steel	Concrete
Nearly level to gently sloping; seasonal high water table; high susceptibility to frost action; fair stability; seasonal wetness hinders construction.	Fair stability; low to moderate shrink-swell potential; medium compressibility; seasonal high water table.	Loamy, seasonal high water table; fair stability on thawing.	Severe: moderately slow permeability; seasonal high water table.	High	Low.
Level; water table at surface; high susceptibility to frost action; frequent flooding; organic material is unstable and must be removed.	Very poor stability; variable shrink-swell potential; high compressibility; high water table.	Organic material and marl; high water table; wet conditions hinder operations; very poor stability on thawing.	Severe: variable permeability; high water table; unstable organic material; disposal field saturated during wet periods.	High	Low.
Cuts and fills often needed, well drained; low susceptibility to frost action; fair stability.	Fair stability; low shrink-swell potential; slight compressibility; well drained.	Loamy; good stability on thawing.	Slight on slopes of 0 to 12 percent: moderate permeability; possible pollution of shallow water supplies. Moderate on slopes of 12 to 18 percent: installation and operation of disposal fields are difficult on slopes of more than 12 percent. Severe on slopes of 18 to 40 percent: too steep and complex.	Low	Low.
Nearly level; high water table; low susceptibility to frost action; fair stability; wetness hinders construction.	Fair stability; low shrink-swell potential; slight compressibility; high water table; flows when wet.	Loamy; high water table; wetness hinders operations; fair stability on thawing.	Severe: moderately rapid permeability; high water table; disposal field saturated during wet periods.	Low	Low.
Cuts and fills often needed; well drained; low susceptibility to frost action; fair stability.	Fair stability; low to moderate shrink-swell potential; slight to medium compressibility; well drained.	Loamy; fair stability on thawing.	Slight on slopes of 0 to 12 percent: moderate permeability. Moderate on slopes of 12 to 18 percent: installation and operation of disposal fields are difficult on slopes of more than 12 percent. Severe on slopes of 18 to 25 percent: too steep and complex.	Low	Low.
Nearly level; high water table; high susceptibility to frost action; unstable organic soil.	Very poor stability; variable shrink-swell potential; high compressibility; high water table.	Organic material; high water table; wetness hinders operations; very poor stability on thawing.	Severe: moderately rapid permeability; high water table; disposal field saturated during wet periods.	High	Moderate.
Nearly level; high water table; high susceptibility to frost action; poor stability; wetness hinders construction.	Poor stability; low to moderate shrink-swell potential; medium compressibility; high water table.	Loamy; high water table; wetness hinders operations; poor stability on thawing.	Severe: moderate permeability; high water table; disposal fields saturated during wet periods.	High	Low.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill
Linwood: Lm	Poor: organic soil erodible and oxidizes readily; high water table.	Not suitable: shallow organic soil.	Not suitable: shallow organic soil.	Not suitable: inorganic material; variable shrink-swell potential; high compressibility; poor compaction; very poor stability. Fair in substratum: low to moderate shrink-swell potential; medium compressibility; poor compaction and stability; wetness hinders construction.
Locke: LoB	Fair: to depth of 8 to 14 inches; loamy; medium organic-matter content; seasonal high water table.	Not suitable: underlain by sandy loam.	Not suitable: underlain by sandy loam.	Fair: low shrink-swell potential; slight compressibility; good compaction; good stability.
Metamora: MlB	Fair: to depth of 8 to 12 inches; loamy; moderate content of organic matter; seasonal high water table.	Not suitable: underlain by clay loam material.	Not suitable: underlain by clay loam material.	Fair: low shrink-swell potential; medium compressibility; fair compaction and good stability.
Metea: MnA, MnB, MnC	Poor: to depth of 7 to 10 inches; sandy; low organic-matter content.	Poor: limited source; 18 to 40 inches of sandy material.	Not suitable: loamy sand underlain by loam and clay loam material.	Fair: low to moderate shrink-swell potential; medium compressibility; fair compaction; fair stability.
*Miami: MoA, MoB, MoC, MoD, MoE, MoF, MrB. For the Conover part of MrB, see the Conover series.	Fair: to depth of 6 to 10 inches; loamy; medium organic-matter content.	Not suitable: underlain by loam.	Not suitable: underlain by loam.	Fair: low to moderate shrink-swell potential; medium compressibility; fair compaction and stability.
*Minoa: MwB. For the Thetford part, see the Thetford series.	Fair: to depth of 8 to 12 inches; sandy; low organic-matter content; water table at 1 or 2 feet.	Not suitable: underlain by stratified fine sand, silt loam, and silt.	Not suitable: underlain by fine sand, silt loam, and silt.	Fair: low shrink-swell potential; slight compressibility; poor compaction and stability; water table at depth of 1 or 2 feet; material flows when wet.

interpretations—Continued

Soil features affecting—			Degree and kinds of limitation for septic tank disposal field	Corrosion potential for conduits of—	
Highway location	Foundations for low buildings	Winter grading		Uncoated steel	Concrete
Nearly level; high water table; high susceptibility to frost action; unstable organic soil.	Very poor stability; variable shrink-swell potential; high compressibility in muck; high water table.	Organic material; high water table; wetness hinders operations; very poor stability on thawing.	Severe: moderately rapid permeability in organic material, moderately slow in substratum; high water table; unstable organic material; disposal field saturated during wet periods.	High	Low.
Nearly level to gently sloping; seasonal high water table; moderate susceptibility to frost action; good stability; seasonal wetness may hinder construction.	Good stability; low shrink-swell potential; slight compressibility; seasonal high water table.	Loamy; seasonal high water table; wetness hinders operations in some areas; fair stability on thawing.	Severe: moderate permeability; seasonal high water table.	Moderate	Low.
Nearly level to gently sloping; seasonal high water table; moderate susceptibility to frost action; fair stability; wetness hinders construction in some areas.	Fair stability; moderate shrink-swell potential; medium compressibility; seasonal high water table.	Loamy; seasonal high water table; wetness hinders operations in some areas; fair stability on thawing.	Severe: moderate permeability in the upper part, moderately slow in the lower part; seasonal high water table.	High	Low.
Cuts and fills needed in few areas; well drained; high susceptibility to frost action; fair stability.	Fair stability; low to moderate shrink-swell potential; medium compressibility; well drained.	Sandy; poor stability on thawing.	Moderate to severe: rapid permeability in the upper part, moderately slow in the lower part; onsite investigation needed.	Moderate	Low.
Cuts and fills often needed; well drained; high susceptibility to frost action; fair stability.	Fair stability; low to moderate shrink-swell potential; medium compressibility; well drained.	Loamy; fair stability on thawing.	Slight on slopes of 0 to 12 percent: moderate permeability. Moderate on slopes of 12 to 18 percent: installation and operation of disposal fields are difficult on slopes of more than 12 percent. Severe on slopes of 18 to 35 percent; too steep and complex.	Moderate	Low.
Nearly level to gently sloping; seasonal high water table; moderate susceptibility to frost action; fair stability; wetness hinders construction in some areas.	Poor stability; low shrink-swell potential; slight compressibility; seasonal high water table.	Sandy; seasonal high water table; wetness hinders operations in some areas; poor stability on thawing.	Severe: moderate permeability; seasonal high water table.	Moderate	Low.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill
Oakville: OaB	Poor: to depth of 6 to 8 inches; sandy; low organic-matter content; subject to soil blowing.	Good: sandy material to depth greater than 60 inches.	Not suitable: underlain by fine sand.	Fair: low shrink-swell potential; slight compressibility; fair compaction; poor stability.
OkB	Poor: to depth of 6 to 8 inches; sandy; low organic-matter content; subject to soil blowing.	Fair: 40 to 66 inches of sandy material.	Not suitable: fine sand; underlain by loam material.	Fair: for sandy material; low shrink-swell potential; slight compressibility; fair compaction; poor stability. Fair: for loamy material; low shrink-swell potential; medium compressibility; poor compaction and stability.
Oshtemo. Mapped only with Boyer series.	Poor: to depth of 8 to 10 inches; sandy; low organic-matter content.	Good: gravelly sand.	Fair: dominantly sandy material with 30 to 40 percent gravel.	Good: low shrink-swell potential; slight compressibility; fair compaction and stability; substratum provides good subgrade material.
Ottokee: OlA, OlB	Poor: to depth of 6 to 9 inches; sandy; low organic-matter content; subject to soil blowing.	Good: sandy with thin layers of loamy sand.	Not suitable: underlain by sand.	Fair: low shrink-swell potential; slight compressibility; fair compaction and stability.
*Owosso: OmA, OmB, OmC, OmD. For the Miami part, see the Miami series.	Fair: to depth of 8 to 10 inches; loamy; moderately low organic-matter content.	Not suitable: underlain by clay loam and loam material.	Not suitable: underlain by clay loam and loam material.	Fair: low to moderate shrink-swell potential; medium compressibility; fair stability.
Pewamo: Pc	Poor: to depth of 9 to 12 inches; loamy; high organic-matter content; high water table.	Not suitable: underlain by silty clay loam.	Not suitable: underlain by silty clay loam.	Poor: moderate to high shrink-swell potential; medium compressibility; good compaction; fair stability; wetness hinders excavation.

interpretations—Continued

Soil features affecting—			Degree and kinds of limitation for septic tank disposal field	Corrosion potential for conduits of—	
Highway location	Foundations for low buildings	Winter grading		Uncoated steel	Concrete
Cuts and fills often needed; well drained; low susceptibility to frost action; poor stability; loose sand sometimes hinders construction; subject to soil blowing.	Poor stability; low shrink-swell potential; slight compressibility; well drained.	Sandy; low moisture content; good stability on thawing.	Slight on slopes of 0 to 12 percent: rapid permeability; possible pollution of shallow water supplies. Moderate on slopes of 12 to 18 percent: installation and operation of disposal fields are difficult on slopes of more than 12 percent. Severe on slopes of 18 to 35 percent: too steep.	Low	Low.
Nearly level; gently sloping; well drained; sandy material has low susceptibility to frost action; poor stability; loose sand sometimes hinders construction; subject to soil blowing. Substratum: high susceptibility to frost action; poor stability.	Poor stability; low shrink-swell potential; medium compressibility; well drained.	Sandy; low moisture content; good stability on thawing.	Slight to moderate: moderate permeability; possible pollution of shallow water supplies; where loamy material is at depth of less than 48 inches disposal fields may be saturated during wet periods; need onsite investigation.	Low in sand; moderate in loam.	Low.
Cuts and fills often needed; well drained; low susceptibility to frost action; fair stability.	Fair stability; low shrink-swell potential; slight compressibility; well drained.	Sandy; low moisture content; good stability on thawing.	Slight on slopes of 0 to 12 percent: moderate permeability; possible pollution of shallow water supplies. Moderate on slopes of 12 to 18 percent: installation and operation of disposal fields are difficult on slopes of more than 12 percent. Severe on slopes of 18 to 35 percent: too steep.	Low	Low.
Nearly level to gently sloping; moderately well drained; low susceptibility to frost action; fair stability; loose sand may hinder construction; subject to soil blowing.	Fair stability; low shrink-swell potential; slight compressibility; moderately well drained.	Sandy; low moisture content; good stability on thawing.	Moderate: rapid permeability; moderately well drained; possible pollution of shallow water supplies; water table within 3 feet of surface during wet periods.	Low	Low.
Cuts and fills needed in some areas; well drained; high susceptibility to frost action; fair stability.	Fair stability; low to moderate shrink-swell potential; medium compressibility; well drained.	Loamy; fair stability on thawing.	Moderate: moderately rapid permeability in upper part, moderately slow in lower part; well drained; slopes of more than 12 percent hinder installation and operation of disposal fields.	High	Low.
Nearly level; high water table; high susceptibility to frost action; fair stability; wetness hinders construction.	Fair stability; moderate shrink-swell potential; medium compressibility; high water table.	Loamy; high water table; wetness hinders operations; poor stability on thawing.	Severe: moderately slow permeability; high water table; disposal field saturated during wet periods.	High	Low.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill
Rifle: Rf	Poor: organic soil; water table at surface; erodible and oxidizes readily.	Not suitable: organic soil.	Not suitable: organic soil.	Not suitable: variable shrink-swell potential; high compressibility; poor compaction; very poor stability; wetness hinders excavation.
Sebewa: Se	Poor: to depth of 9 to 14 inches; loamy; high organic-matter content; high water table.	Fair: gravelly sand and some fines; high water table.	Fair: gravelly sand and some fines; high water table.	Poor: low shrink-swell potential; slight compressibility; fair compaction and stability.
*Spinks: SvB, SvC, SvD, SvE, SvF. For the Oakville part, see the Oakville series.	Poor: to depth of 6 to 9 inches; sandy; low organic-matter content; subject to soil blowing.	Good: sandy; thin layers of loamy sand.	Not suitable: underlain by sand.	Fair: low shrink-swell potential; slight compressibility; fair compaction and stability.
Tawas: Tm	Poor: organic soil erodible and oxidizes readily; high water table.	Poor: sandy material at a depth ranging from 12 to 40 inches; high water table.	Not suitable: organic soil over sand.	Not suitable: organic material 12 to 40 inches thick. Fair in sandy substratum; low shrink-swell potential; slight compressibility; poor stability; wetness hinders excavation.
Thetford. Mapped only in a complex with Minoa soils.	Poor: to depth of 6 to 8 inches; sandy; low organic-matter content; seasonal high water table.	Fair: sandy with thin layers of loamy sand; seasonal high water table.	Not suitable: underlain by sand.	Fair: low shrink-swell potential; slight compressibility; fair compaction; poor stability; seasonal high water table.
Warners: Wc	Poor: to depth of 0 to 12 inches; poor chemical and physical properties; high water table.	Not suitable: loam underlain by marl.	Not suitable: loam underlain by marl.	Not suitable: high compressibility; variable shrink-swell potential; poor compaction and stability; high water table.
Wasepi: WeA	Fair: to depth of 8 to 10 inches; sandy; moderate organic-matter content; seasonal high water table.	Fair: sandy and some fine gravel below depth of about 24 inches, seasonal high water table.	Fair: less than 50 percent gravel; seasonal high water table.	Fair: low shrink-swell potential; slight compressibility; fair compaction and stability; wetness hinders excavation in some areas.
Washtenaw: Wh	Poor: to depth of 8 to 18 inches; loamy; medium organic-matter content; high water table.	Not suitable: underlain by loamy material.	Not suitable: underlain by loamy material.	Poor: variable shrink-swell potential; medium compressibility; poor compaction and stability; high water table.

interpretations—Continued

Soil features affecting—			Degree and kinds of limitation for septic tank disposal field	Corrosion potential for conduits of—	
Highway location	Foundations for low buildings	Winter grading		Uncoated steel	Concrete
Nearly level; high water table; high susceptibility to frost action; very poor stability; wetness hinders construction.	Very poor stability; variable shrink-swell potential; high compressibility; high water table.	Organic material; high water table; wetness hinders operations; very poor stability on thawing.	Severe: moderately rapid permeability; high water table; nearly level; unstable organic material; filter field saturated during wet periods.	High	High.
Nearly level; high water table; moderate susceptibility to frost action; fair stability; wetness hinders construction.	Fair stability; low shrink-swell potential; slight compressibility; high water table.	Loamy; high water table; wetness hinders operations; poor to fair stability on thawing.	Severe: moderate permeability; high water table; disposal field saturated during wet periods.	High	Low.
Cut and fills needed in some areas; well drained; low susceptibility to frost action; fair stability; loose sand may hinder construction; subject to soil blowing.	Fair stability; low shrink-swell potential; slight compressibility; well drained.	Sandy; low moisture content; good stability on thawing.	Slight on slopes of 0 to 12 percent: moderately rapid permeability; possibility of polluting shallow water supplies. Moderate on slopes of 12 to 18 percent: installation and operation of disposal fields are difficult on slopes of more than 12 percent. Severe on slopes of 18 to 35 percent: too steep.	Low	Low.
Nearly level; high water table; high susceptibility to frost action; very poor stability; wetness hinders excavation.	Fair stability; low shrink-swell potential; slight compressibility; high water table.	Organic material; high water table; wetness hinders operations; very poor stability on thawing.	Severe: moderately rapid permeability; high water table; unstable organic material; disposal field saturated during wet periods.	High	Low.
Nearly level; seasonal high water table; low susceptibility to frost action; poor stability; wetness hinders construction in some areas.	Poor stability; low shrink-swell potential; slight compressibility; seasonal high water table.	Sandy; seasonal high water table; wetness hinders operations in some areas; poor stability on thawing.	Severe: moderately rapid permeability; seasonal high water table; possible pollution of shallow water supplies; disposal fields saturated during wet periods.	Moderate	Low.
Nearly level; high water table; high susceptibility to frost action; poor stability; wetness hinders construction.	Poor stability; variable shrink-swell potential; high compressibility; high water table.	Loamy and marl; high water table; wetness hinders operations; poor stability on thawing.	Severe: variable permeability; high water table; disposal field saturated during wet periods.	High	Low.
Nearly level; seasonal high water table; low susceptibility to frost action; fair stability; wetness hinders construction in some areas.	Fair stability; low shrink-swell potential; slight compressibility; seasonal high water table.	Loamy; seasonal high water table; wetness hinders operations in some areas; fair stability on thawing.	Severe: moderately rapid permeability seasonal high water table; possible pollution of shallow water supplies; disposal field saturated during wet periods.	Moderate	Low.
Nearly level; high water table; high susceptibility to frost action; poor stability; wetness hinders construction.	Poor stability; low shrink-swell potential; medium compressibility; high water table.	Loamy, high water table; wetness hinders operations; poor stability on thawing.	Severe: moderately slow permeability; high water table; disposal field saturated during wet periods.	High	Low.

TABLE 6.—*Engineering*

[Not listed in this table are Alluvial land (Ad), Borrow pits (Bp), Gravel pits (Gr), Lake beaches (La), and Made land (Md). These land made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and

Soil series and map symbols	Soil features affecting—		
	Agricultural drainage	Irrigation	Terraces and diversions
Arkport: ApA, ApB, ApC	Not needed	Moderate available water capacity; rapid water intake rate; nearly level to strongly sloping.	Moderate permeability; loamy and sandy subsoil; mostly gentle slopes; little runoff.
Barry: Ba	High water table; moderate permeability; sandy pockets; nearly level; some wet depressions.	Moderate available water capacity; moderately rapid water intake rate; nearly level; drainage required.	Not needed.
Berville: Be	High water table; moderately slow permeability; nearly level; some wet depressions.	High available water capacity; medium water intake rate; nearly level; drainage required.	Not needed.
*Boyer: BrA, BrB, BrC, BtA, BtB, BtC, BtD, BtE, BtF. For the Oshtemo part of BtA, BtB, BtC, BtD, BtE, and BtF, see the Oshtemo series.	Not needed	Low available water capacity; rapid water intake rate; sloping areas subject to runoff and erosion.	Moderately rapid permeability; gravelly subsoil; slopes greater than 12 percent hinder construction; difficult to vegetate; erodible; moderate depth to gravelly sand.
BsA, BsB	Not needed	Moderate available water capacity; rapid water intake rate; nearly level to gently sloping.	Moderately rapid permeability; gravelly loamy subsoil; gentle slopes; difficult to vegetate; erodible; moderate depth to gravelly sand.
Brady: BuA	High water table; moderately rapid permeability; fine soil may clog tile.	Low available water capacity; rapid water intake rate; nearly level; drainage generally required.	Not needed.
Breckenridge: Bv	High water table; moderately rapid permeability; nearly level; depressions need surface drains in some places.	Moderate available water capacity; rapid water intake rate; nearly level; drainage required.	Not needed.
Bronson: BwA	Not needed	Low available water capacity; rapid water intake rate; nearly level.	Not needed.
Brookston: By	High water table; moderately slow permeability; nearly level; depressions often wet.	High available water capacity; medium water intake rate; nearly level; drainage required.	Not needed.
Carlisle: Cc	High water table; moderately rapid permeability; water level control desirable to reduce subsidence; ditchbanks unstable and require frequent maintenance; nearly level.	Very high available water capacity; very rapid water intake rate; nearly level; drainage required.	Not needed.
Colwood: Cr	High water table; moderate permeability; fine soil material may clog tile; ditchbanks unstable; nearly level.	High available water capacity; medium water intake rate; nearly level; drainage required.	Not needed.
*Conover: CvA, CvB, CxA. For the Miami part of CxA, see the Miami series.	High water table; moderately slow permeability; nearly level to gently sloping; wet depressions need surface drains.	High available water capacity; medium water intake rate; nearly level to gently sloping; drainage generally needed.	Not needed.

interpretations for farm uses

types are variable and require onsite investigation. An asterisk in the first column indicates that at least one mapping unit in this series is for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Soil features affecting—Continued		
Grassed waterways	Farm ponds	
	Reservoir area	Embankments
Loamy; well drained; mostly gentle slopes.	Well drained; medium seepage rate; moderate permeability, but moderately rapid in substratum; sides of ponds unstable.	Well drained; good stability; fair compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Not needed	High water table; medium seepage rate; moderate permeability.	High water table; fair stability; fair compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Not needed	High water table; medium seepage rate; moderately slow permeability.	High water table; fair stability and compaction; poor resistance to piping; slight to medium compressibility; low to moderate shrink-swell potential.
Sandy; well drained; sloping soils subject to runoff and erosion; difficult to vegetate if cuts expose gravelly sand.	Well drained; rapid seepage rate; moderately rapid permeability, but rapid in substratum.	Well drained; fair stability and compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Sandy; well drained; difficult to vegetate if cuts expose gravelly sand.	Well drained; rapid seepage rate; moderately rapid permeability.	Well drained; fair stability and compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Not needed	High water table; rapid seepage rate; permeability moderately rapid in subsoil but rapid in substratum.	High water table; fair stability; good compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Not needed	High water table; moderately rapid seepage rate but rapid in subsoil and moderately slow in substratum.	High water table; good stability; fair compaction; poor resistance to piping; medium compressibility; low shrink-swell potential.
Not needed	Moderately well drained; rapid seepage rate; moderately rapid permeability in subsoil but rapid in substratum.	Moderately well drained; fair stability and compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Not needed	High water table; slow seepage rate; moderately slow permeability.	High water table; fair stability and compaction; good resistance to piping; medium compressibility; low to moderate shrink-swell potential.
Not needed	High water table; rapid seepage rate; moderately rapid permeability; caving in of organic material common.	High water table; very poor stability; poor compaction; poor resistance to piping; high compressibility; variable shrink-swell potential.
Not needed	High water table; medium seepage rate; moderate permeability; sides of ponds unstable.	High water table; poor stability and compaction; poor resistance to piping; medium compressibility; low to moderate shrink-swell potential.
Not needed	High water table; slow seepage rate; moderately slow permeability.	High water table; fair stability and compaction; good resistance to piping; medium compressibility; low to moderate shrink-swell potential.

TABLE 6.—*Engineering*

Soil series and map symbols	Soil features affecting— Agricultural drainage	Irrigation	Terraces and diversions
Edwards: Ed	High water table; variable permeability; water level control desirable to reduce subsidence; ditchbanks unstable and need frequent maintenance; nearly level.	High available water capacity; very rapid water intake rate; nearly level drainage required.	Not needed.
*Fox: FoA, FoB, FoC, FrB, FrC, FrD, FrE, FrF. For the Boyer part of FrB, FrC, FrD, FrE, and FrF, see the Boyer series.	Not needed.	Moderate available water capacity; rapid water intake rate; sloping; subject to run off and erosion.	Moderate permeability; loamy subsoil; complex slopes; slopes greater than 12 percent hinder construction; difficult to vegetate; erodible; moderate depth to gravelly sand.
Gilford: Gd	High water table; moderately rapid permeability; fine soil material may clog drains; nearly level.	Low available water capacity; rapid water intake rate; nearly level; drainage required.	Not needed.
Hillsdale: HdB, HdC, HIB, HIC, HID, HIE, HmB, HmC.	Not needed.	Moderate available water capacity; moderately rapid water intake rate; sloping areas subject to run-off and erosion.	Moderate permeability; loamy subsoil; complex slopes; slopes greater than 12 percent hinder construction.
Houghton: Ho	High water table; moderately rapid permeability; controlled water level desirable to reduce subsidence; ditchbank unstable and need frequent maintenance; nearly level.	Very high available water capacity; very rapid water intake rate; nearly level; drainage required.	Not needed.
Lamson: Lc	High water table; moderate permeability; fine soil material may clog tile; ditchbanks unstable; nearly level.	Moderate available water capacity; rapid water intake rate; nearly level; drainage required.	Not needed.
Linwood: Lm	High water table; moderately rapid permeability in organic material; moderately slow in substratum; water level control desirable to reduce subsidence; ditchbanks unstable; nearly level.	Very high available water capacity; very rapid water intake rate; nearly level; drainage required.	Not needed.
Locke: LoB	High water table; moderate permeability; nearly level to gently sloping; wet depressions need surface drains.	Moderate available water capacity; rapid water intake rate; nearly level to gently sloping; drainage generally required.	Not needed.
Metamora: MIB	High water table; moderate permeability in upper part; moderately slow in lower part; nearly level to gently sloping; wet depressions may need random tile or surface drains.	Moderate available water capacity; moderately rapid water intake rate; nearly level to gently sloping; drainage generally needed.	Not needed.
Metea: MnA, MnB, MnC	Not needed.	Moderate available water capacity; rapid water intake rate; sloping areas subject to runoff and erosion.	Rapid permeability in upper part, moderately slow in substratum; sandy over loamy material; sloping areas erode readily; difficult to vegetate.

interpretations for farm uses—Continued

Soil features affecting—Continued		
Grassed waterways	Farm ponds	
	Reservoir area	Embankments
Not needed	High water table; rapid seepage rate in organic material and variable in marl; variable permeability; caving in of organic material common.	High water table; very poor stability; poor compaction; poor resistance to piping; high compressibility; variable shrink-swell potential.
Loamy; well drained; sloping areas subject to runoff and erosion.	Well drained; seepage rate medium in subsoil and rapid in substratum; permeability moderate in subsoil and rapid in substratum.	Well drained; fair stability and compaction; good resistance to piping; slight compressibility; low shrink-swell potential.
Not needed	High water table; rapid seepage rate; permeability moderately rapid in subsoil and rapid in substratum; sides of ponds unstable.	High water table; fair stability and compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Sandy and loamy; well drained; sloping areas subject to runoff and erosion.	Well drained; moderately rapid seepage rate; moderate permeability.	Well drained; good stability and compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Not needed	High water table; rapid seepage rate; moderately rapid permeability; caving of organic material common.	High water table; very poor stability; poor compaction; poor resistance to piping; high compressibility; variable shrink-swell potential.
Not needed	High water table; moderately rapid seepage rate; moderate permeability; sides of ponds are unstable.	High water table; poor stability and compaction; poor resistance to piping; medium compressibility; low to moderate shrink-swell potential.
Not needed	High water table; rapid seepage rate in organic material, medium seepage rate in substratum; permeability moderately rapid in organic material and moderately slow in substratum; caving of organic material common.	High water table; 12 to 40 inches of organic material; very poor stability; poor compaction; substratum has poor stability and compaction; poor resistance to piping; compressibility high in muck and medium in substratum; shrink-swell potential variable in muck and low to moderate in substratum.
Loamy; somewhat poorly drained; nearly level to gently sloping.	High water table; medium seepage rate; moderate permeability.	High water table; good stability; good compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Loamy; somewhat poorly drained; nearly level to gently sloping.	High water table; medium seepage rate; moderate permeability in the upper part and moderately slow in the lower part.	High water table; good stability; fair compaction; good resistance to piping; slight to medium compressibility; shrink-swell potential low in upper part and moderate in the substratum.
Sandy; well drained; sloping areas erode readily and are difficult to vegetate.	Well drained; rapid seepage rate in upper part and slow in the lower part; permeability rapid in the upper part and moderate in the lower part.	Well drained; fair stability and compaction; good resistance to piping; medium compressibility; shrink-swell potential low in the upper part and low to moderate in the substratum.

TABLE 6.—*Engineering*

Soil series and map symbols	Soil features affecting— Agricultural drainage	Irrigation	Terraces and diversions
*Miami: MoA, MoB, MoC, MoD, MoE, MoF, MrB. For the Conover part of MrB, see the Conover series.	Not needed	High available water capacity; medium water intake rate; sloping areas subject to runoff and erosion.	Moderate permeability; loamy subsoil; complex slopes; slopes greater than 12 percent hinder construction; subject to runoff and erosion.
*Minoa: MwB. For the Thetford part, see the Thetford series.	High water table; moderate permeability; fine soil material may clog tile; ditchbanks unstable; nearly level to gently sloping.	Moderate available water capacity; rapid water intake rate; nearly level to gently sloping; drainage generally needed.	Not needed
Oakville:			
OaB	Not needed	Low available water capacity; rapid water intake rate; nearly level to steep; frequent water applications needed; subject to soil blowing.	Rapid permeability; sandy subsoil; slopes greater than 12 percent hinder construction; difficult to vegetate; subject to soil blowing.
OkB	Not needed	Low available water capacity; rapid water intake rate; level to gently sloping; frequent water applications needed; subject to soil blowing.	Moderate permeability; sandy subsoil; difficult to vegetate; subject to soil blowing.
Oshtemo. Mapped only in complexes with Boyer series.	Not needed	Low available water capacity; rapid water intake rate; sloping areas subject to runoff and erosion.	Moderate permeability; sandy and loamy subsoil; slopes greater than 12 percent hinder construction; difficult to vegetate; erodible.
Ottokee: OlA, OlB	Not needed	Low available water capacity; rapid water intake rate; nearly level to gently sloping; subject to soil blowing.	Not needed
*Owosso: OmA, OmB, OmC, OmD. For the Miami part, see the Miami series.	Not needed	Moderate available water capacity; moderately rapid water intake rate; sloping areas subject to runoff and erosion.	Moderately rapid permeability in the upper part, moderately slow in substratum; loamy subsoil; complex slopes; slopes greater than 12 percent hinder construction; erodible.
Pewamo: Pc	High water table; moderately slow permeability; nearly level; wet depressions need surface drains.	High available water capacity; slow water intake rate; nearly level; drainage required.	Not needed
Rifle: Rf	High water table; moderately rapid permeability; water level control desirable to reduce subsidence; ditchbanks unstable and need frequent maintenance; nearly level.	Very high available water capacity; very rapid water intake rate; nearly level; drainage required.	Not needed
Sebewa: Se	High water table; moderate permeability; nearly level; wet depressions need surface drains.	Moderate available water capacity; medium water intake rate; nearly level; drainage required.	Not needed
*Spinks: SvB, SvC, SvD, SvE, SvF. For the Oakville part, see the Oakville series.	Not needed	Low available water capacity; rapid water intake rate; sloping areas subject to soil blowing.	Moderately rapid permeability; sandy subsoil; slopes greater than 12 percent hinder construction; difficult to vegetate; erodible.

interpretations for farm uses—Continued

Soil features affecting—Continued		
Grassed waterways	Farm ponds	
	Reservoir area	Embankments
Loamy; well drained; sloping areas subject to runoff and erosion.	Well drained; slow seepage rate; moderate permeability.	Well drained; fair stability and compaction; good resistance to piping; medium compressibility; low to moderate shrink-swell potential.
Not needed	High water table; rapid seepage rate; moderate permeability; sides of pond are unstable.	High water table; poor stability and compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Sandy; well drained; nearly level to very steep; difficult to vegetate.	Well drained; rapid seepage rate; rapid permeability.	Well drained; poor stability; fair compacpion; poor resistance to piping; slight compressibility; low shrink-swell potential.
Sandy; well drained; nearly level or gently sloping; low runoff; difficult to vegetate.	Well drained; rapid seepage rate in sandy material, slow seepage rate in substratum; permeability rapid in upper part and moderate in substratum.	Well drained; sandy material has poor stability, fair compaction, poor resistance to piping; loamy substratum has poor stability, compaction, poor resistance to piping, medium compressibility, low shrink-swell potential.
Sandy; well drained; sloping areas subject to runoff and erosion and are difficult to vegetate.	Well drained; rapid seepage rate; permeability moderate in subsoil and rapid in substratum.	Well drained; fair stability and compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Not needed	Moderately well drained; rapid seepage rate; rapid permeability.	Moderately well drained; fair stability and compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Loamy; well drained; sloping areas subject to runoff and erosion.	Well drained; medium seepage rate; permeability moderately rapid in the upper part and moderately slow in the substratum.	Well drained; fair stability and compaction; good resistance to piping; medium compressibility; low to moderate shrink-swell potential.
Not needed	High water table; slow seepage rate; moderately slow permeability.	High water table; fair stability and compaction; good resistance to piping; medium compressibility; moderate to high shrink-swell potential.
Not needed	High water table; rapid seepage rate; moderately rapid permeability; caving in of organic material common.	High water table; very poor stability; poor compaction; poor resistance to piping; high compressibility; variable shrink-swell potential.
Not needed	High water table; rapid seepage rate; moderate permeability.	High water table; fair stability; good compaction; fair resistance to piping; slight compressibility; low shrink-swell potential.
Sandy; well drained; nearly level to very steep; difficult to vegetate.	Well drained; rapid seepage rate; moderately rapid permeability.	Well drained; fair stability and compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.

TABLE 6.—*Engineering*

Soil series and map symbols	Soil features affecting—		
	Agricultural drainage	Irrigation	Terraces and diversions
Tawas: Tm	High water table; moderately rapid permeability; water level control desirable to reduce subsidence; ditchbanks unstable and need frequent maintenance; nearly level.	Moderate available water capacity; very rapid water intake rate; nearly level; drainage required.	Not needed
Thetford. Mapped only in a complex with Minoa series.	High water table; moderately rapid permeability; fine soil material may clog drains; ditchbanks unstable; nearly level to gently sloping.	Low available water capacity; rapid water intake rate; nearly level to gently sloping; drainage generally needed.	Not needed
Warners: Wc	High water table; variable permeability; marl substratum; unstable ditchbanks; nearly level.	High available water capacity; moderately rapid water intake rate; nearly level; drainage required.	Not needed
Wasepi: WeA	High water table; moderately rapid permeability; fine soil material may clog tile; nearly level.	Low available water capacity; rapid water intake rate; nearly level; drainage generally needed.	Not needed
Washtenaw: Wh	High water table; subject to ponding; moderately slow permeability; nearly level; wet depressions require surface drains.	High available water capacity; medium water intake rate; nearly level; drainage required.	Not needed

aeration, content of water, and movement of water. The reaction of the soil also may be important.

Table 6 lists features that affect the use of the soils for agricultural drainage, irrigation, terraces and diversions, grassed waterways, and farm ponds.

Listed under agricultural drainage are features that affect the installation and performance of surface and subsurface drainage systems. Such features are texture, permeability, relief, restricting layers, and depth to water table. Artificial drainage is needed in areas that have been cleared for farming. Many wet areas in the county that are used for pasture would be suited to crops if they were adequately drained and managed.

The major features affecting suitability of the soils for irrigation are available water capacity and rate of water intake. Also important are relief, the need for drainage, and depth to soil material that restricts growth of roots. Little irrigation is now done in the county, though many of the soils are suitable for irrigation. If irrigated, the large acreage of sandy soils in the county would be suitable for many crops, including many specialty crops. In many areas water for irrigation can be obtained from shallow wells or lakes.

Important features that affect the layout and construction of terraces and diversions are relief, texture of the soil material, and depth to material that restricts growth of roots. Most of the sloping soils on uplands in the county have properties that are suitable for the construction of terraces and diversions. In many places, however, the slopes are too irregular for terraces.

The success of grassed waterways depends on soil features that affect the construction and maintenance of the waterways and the growth of plants within them. Important features are fertility, available water capacity, rate of surface runoff, and susceptibility to erosion. Establishing a dense sod that is resistent to erosion is needed for well-constructed waterways.

The seepage rate of undisturbed soil material is the most important feature affecting the reservoir area of a farm pond. Features affecting embankments are compaction properties, stability, seepage rate, and the piping hazard. Because of the slow seepage rate, the soils that formed in loam, clay loam, and silty clay loam are favorable for construction of farm ponds. The soils that formed in sandy loam materials have a moderately rapid seepage rate, which results in wide fluctuations in the water level. Successful ponds can be constructed on these soils, however, by careful selection of materials from the subsoil for use in blanketing the reservoir area and by compacting the material. The soils that formed in sand and loamy sand have a rapid seepage rate and are not suitable sites for ponds. Springs in many low areas in the county provide a good flow of water. Ponds can be constructed in these areas, even though the seepage rate is rapid. Careful study of the areas is needed before constructing ponds.

interpretations for farm uses—Continued

Soil features affecting—Continued		
Grassed waterways	Farm ponds	
	Reservoir area	Embankments
Not needed	High water table; rapid seepage rate; moderately rapid permeability; caving in of organic material is common.	High water table; 12 to 40 inches of organic material; very poor stability; poor compaction; poor resistance to piping; high compressibility; variable shrink-swell potential; sandy substratum has fair stability and compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Not needed	High water table; rapid seepage rate; moderately rapid permeability; sides of ponds are unstable.	High water table; poor stability; fair compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Not needed	High water table; variable seepage rate; variable permeability; sides of ponds are unstable.	High water table; poor stability and compaction; poor resistance to piping; high compressibility; variable shrink-swell potential.
Not needed	High water table; medium seepage rate in upper 24 to 40 inches but rapid in substratum; moderately rapid permeability.	High water table; fair stability and compaction; poor resistance to piping; slight compressibility; low shrink-swell potential.
Not needed	High water table; medium seepage rate; moderately slow permeability.	High water table; poor stability and compaction; poor resistance to piping; medium compressibility; low shrink-swell potential.

Many of the soil features affecting farm ponds are also applicable to sewage lagoons. Level relief, low water table, and a low content of organic matter are desirable features for lagoons.

Use of Soils for Town and Country Planning

Community development, the accompanying extension of public utilities, and the establishment of business and recreational facilities create a need for soil information. Land appraisers, realtors, city planners, builders, and others need facts that will help them to determine what sites are suitable for homes and other buildings and what areas are best reserved for other uses (fig. 9). This section also provides information for homeowners who want to landscape their property and protect it from the erosion that commonly occurs in built-up communities.

Soil properties have an important effect on the suitability of a site for residential development, whether for a subdivision or an individual home. Soil drainage, permeability, stability of the soil material, frequency of flooding, slope, and erosion hazard are important factors in development. As slopes become steeper, the hazard of erosion increases, as does the susceptibility to land slippage. Layout and construction of streets and utilities also become more difficult. Brookston, Colwood, Gilford, Pewamo, Sebewa, and similar soils are poorly drained or very poorly drained, and they have a high water table unless drained. Dry basements are difficult to maintain in these wet soils.

The section "Engineering Uses of the Soils" gives information on the drainage and other features of the soils. A high water table, even if only seasonal, hinders the proper function of septic tank filter fields and can result in unsanitary conditions. The rate at which water moves downward through the soil influences the suitability for septic tank filter fields. Information regarding this feature is listed under the column "Permeability" in table 4. Sandy soils that have rapid permeability, such as Oakville and Ottokee soils, may allow unfiltered effluent to enter and contaminate shallow water supplies. The column "Limitations for septic tank disposal fields" in table 5 furnishes information about the features of the soils that affect their use for disposal of sewage.

Some soils provide good foundations for houses, whereas others do not. The columns "Shrink-swell potential" in table 4 and "Foundations for low buildings" in Table 5 help in selecting soils that have the fewest limitations for foundations. Boyer, Oakville, Spinks, and similar soils provide good foundations. Carlisle, Edwards, and Tawas soils have severe limitations for foundations because of unstable organic material and marl in and under these soils. Alluvial land and soils on bottom lands are subject to flooding and have severe limitations for houses.

Figure 9.—**Changing land use. Former cropland that is now a residential area. Dairy barns remain in the right background. The soil is a Miami loam, which is moderately well suited to residential construction.**

Important in community development are streets, driveways, and sidewalks; underground utility lines; control of runoff and erosion; gardening and landscaping; and public health. These are discussed in the following paragraphs.

Streets, driveways, and sidewalks

Of special interest to homeowners and developers is the suitability of the soils for streets, driveways, sidewalks, and patios. Soils that have a high silt content, such as Colwood, Lamson, and Minoa soils, are subject to frost heave. Concrete cracks readily if it is placed on these soils without first covering the surface of the soil with sandy and gravelly material. Soils having a high water table and soils having a high clay content also cause pavements and sidewalks to crack and shift excessively.

Very poorly drained Carlisle, Edwards, Linwood, Rifle, and Tawas soils settle readily, especially after they are drained. This settling causes cracking of pavement and an uneven surface. The columns "Shrink-swell potential" in table 4 and "Road fill" and "Highway location" in table 5 provide useful information about the use of soils for streets, driveways, and sidewalks.

Underground utility lines

Water mains, gas pipelines, communication lines, and sewer lines, which are buried in the soil, may corrode and break unless protected against certain electrobiochemical reactions. The reactions result from the inherent properties of the soil and differ according to the kinds of soil. All metals corrode to some degree when buried in the soil, and some metals corrode more rapidly in some soils than in others. The corrosion potential depends on physical, chemical, electrical, and biological characteristics of the soil; for example, oxygen concentration, concentration of anaerobic bacteria, and moisture content. Design and construction also have an influence. The likelihood of corrosion is intensified by connecting dissimilar metals, by burying metal structures at varying depths, and by extending pipelines through different kinds of soil.

In soils that have a high shrink-swell potential, stresses created by volume changes can break cast iron pipe. To prevent breakage, it may be necessary to cushion the pipeline with sandy material. The column "Shrink-swell potential" in table 4 furnishes estimates of the volume changes of the soils upon wetting and drying. The column "Corrosion potential for conduits" in table 5 gives a general rating of the soils for corrosion potential.

Control of runoff and erosion

Erosion and the resulting accumulation of sediment are serious problems in construction areas on sloping soils. Because of the compaction of soil material during construction and the increased surface covered by pavement, runoff from built-up areas may be 2 to 10 times as much as from areas in farms or forest. The runoff concentrates in streets and gutters instead of flowing into natural waterways, and the result is flooding and deposition of sediments in lower areas. Strongly sloping to very steep areas of Boyer, Fox, Hillsdale, and Miami soils are especially subject to rapid runoff and severe erosion.

Small residential areas can be protected by—

1. Locating driveways, walks, and fences on the contour or straight across the slope.
2. Grading to make the surface level or gently sloping. The top layer can be removed prior to grading and later used for topsoil.
3. Building diversions that intercept runoff and keep it from flowing over erodible areas.
4. Constructing or improving waterways to prevent gullying.
5. Draining seepy and waterlogged areas with tile drains or other facilities.

Table 6 provides information on features that affect use of the soils for diversions, grassed waterways, and artificial drainage.

Gardening and landscaping

Homeowners and landscape architects need to know the kinds of soil present in an area before they can select flowers, shrubs, and trees for landscaping.

The best soils for yard and garden plants are those that have a deep root zone, a loamy texture, a balanced supply of plant nutrients, an adequate amount of organic matter, an adequate available water capacity, good drainage, and a structure that allows free movement of water. Miami and Hillsdale soils closely approach the ideal where the slope is not too steep.

Boyer, Oakville, and Spinks soils are so sandy and droughty that lawns and shrubs dry up quickly in dry periods unless they are watered frequently. Poorly drained soils, such as the Brookston and Pewamo, are difficult to work when wet and dry out hard and cloddy. Seeding of lawns is difficult once these soils are disturbed in construction.

The section "Management by Capability Units" gives information that can be helpful for landscaping.

Public health

Soil data can be used in solving many problems that are met in protecting the public health. Among these are sewage disposal, maintenance of a pure water supply, prevention of disease, and provision of safe and adequate shelter.

Sewage lagoons, septic tank systems, and sewer lines need to be located and constructed so that seepage or drainage from them cannot pollute water supplies. Leakage from sewage lagoons built of unsuitable soil material is a cause of pollution. Sandy Oakville and Spinks soils have rapid and moderately rapid permeability and may allow pollution. Wells, streams, and lakes can become contaminated by runoff from clogged disposal fields, and rapid percolation of septic tank effluent can result in pollution of shallow underground water supplies. Table 6 lists soil features that affect the use of each soil in the county for embankments and reservoir areas. The detailed soil map shows the major drainageways of the county and can be used as a general guide in locating disposal fields and sewage lagoons.

In selecting sites for sanitary land fills, it is important to consider the topography and drainage of an area and the characteristics of the soils, including texture, permeability, reaction, and the nature of the underlying material. The detailed soil map can be used to help locate sites and identify the soils. Table 4 gives estimates of pertinent properties of the soils.

The stability of the soils is of major importance in the location of sewer lines. If the gradeline is interrupted, the sewer system breaks down and a public health hazard results. Tables 4 and 5 provide information on shrink-swell potential and corrosion potential.

Mosquitoes, fleas, and other disease-carrying insects breed in or near stagnant water. By use of the soil map and the soil descriptions, it is possible to identify areas subject to flooding and areas likely to be ponded from time to time because of nearly level relief or poor internal drainage. Once these possible trouble spots are located the health hazard can be controlled by spraying and by installing drainage systems to remove the standing water that attracts insects.

Recreation

In this section, the soils of Livingston County are evaluated in terms of their limitations for recreational facilities. The kind of soil is an important factor in determining the type and location of such facilities. The soil map at the back of this survey will be helpful in recreational planning. Many soils have severe limitations for service buildings, campsites, play areas, picnic areas, riding trails, and the like, whereas other soils are highly desirable for such uses. Table 7 lists the degree and kinds of limitations of most of the soils in Livingston County for specified uses. Not included in the table are Alluvial land, Gravel pits, and Lake beaches.

The soils are rated according to their degree of limitations for the following major uses:

Service buildings in recreational areas.—These are areas developed for seasonal and year-round cottages, washrooms, bathhouses, picnic shelters, and service buildings. The most desirable soils are nearly level to gently sloping and have good drainage and a low seasonal water table. Factors considered are wetness, permeability, slope, and stability.

Play areas.—These are areas developed for such uses as playgrounds and athletic fields for organized games such as baseball, tennis, and volleyball. All areas are subject to heavy foot traffic. They require a level or nearly level surface, good drainage, freedom from flooding, and a texture and consistence that provide a firm surface. Play areas should be free of coarse fragments and stones. The soils should be able to support a good turf.

Camp areas.—These are areas suitable as sites for tents and camp trailers and the accompanying activities for outdoor living. Desirable areas require little site preparation. They should be suitable for unsurfaced parking for cars and camp trailers, for heavy foot traffic, and for vehicular traffic. Factors considered are wetness and the flooding hazard, permeability, slope, texture of the surface layer, presence of coarse fragments, and degrees of stoniness. The suitability of the soil for supporting vegetation should be considered in the final evaluation.

Picnic areas.—These are areas to be used for picnic areas and extensive play areas. The most desirable soils are nearly level to gently sloping, have good drainage, are free from flooding during use periods, have a texture and consistence that provides a firm surface, and have the ability to support good vegetative cover. They should also be free of stones.

Paths and trials.—These are areas to be used for foot trails, cross-country hiking, bridle paths, and other intensive uses that require the movement of people. It is assumed that the areas will be used as they occur in nature and that little soil will be moved. The most desirable soils from a physical standpoint have good trafficability. They are well drained, loamy in texture, and nearly level to sloping. They have good stability, are not subject to erosion, and are free of coarse fragments and stones. Consideration should be given to placement of paths and trails on the contour in sloping areas to help control erosion. Variation in the slope of paths and trails may serve to enhance interest, but slopes should not exceed 12 percent for prolonged distances.

The soils are rated in table 7 for three degrees of soil limitations: *slight*, relatively free of limitations or limitations are easily overcome; *moderate*, limitations need to be recognized but can be overcome with good management and careful design; and *severe*, limitations severe enough to make use questionable. The ratings are based on soil limitations only and do not consider other features that may affect the desirability of a site. The rating does not imply that a soil having a severe limitation cannot be put to a practical use if enough expense is incurred to overcome the limitation.

The material in this section is intended to provide a general guide in the location and development of parks and recreational areas. This material is not a substitute for detailed investigation of specific sites.

Additional information that may be helpful to those interested in areas for recreational development is available in the sections "Descriptions of the Soils" and "Engineering Uses of the Soils."

TABLE 7.—*Limitations of soils for recreational uses*

[Not listed in this table are Alluvial land (Ad), Borrow pits (Bp), Gravel pits (Gr), Lake beaches (La), and Made land (Md). These land types are variable and require onsite investigation. An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Soil series and map symbols	Service buildings in recreational areas	Play areas	Camp areas	Picnic areas	Paths and trails
Arkport:					
ApA	Slight	Slight	Slight	Slight	Slight.
ApB	Slight	Moderate: slope	Slight	Slight	Slight.
ApC	Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope	Slight.
Barry: Ba	Severe: seasonal high water table; poor drainage.	Severe: poor drainage.	Severe: poor drainage.	Severe: poor drainage.	Severe: poor drainage.
Berville: Be	Severe: seasonal high water table; poor drainage.	Severe: poor drainage; moderately slow permeability.	Severe: poor drainage; moderately slow permeability.	Severe: poor drainage.	Severe: poor drainage.
Boyer:					
BrA, BsA, BtA	Slight: sandy	Moderate: sandy	Moderate: sandy	Moderate: sandy	Moderate: sandy.
BrB, BsB, BtB	Slight	Moderate: sandy	Moderate: sandy	Moderate: sandy	Moderate: sandy.
BrC, BtC	Moderate: slope	Severe: slope	Moderate: sandy	Moderate: sandy	Moderate: sandy.
BtD, BtE	Severe: slope	Severe: slope	Severe: sandy; slope.	Severe: sandy; slope.	Moderate: sandy. slope.
BtF	Severe: slope	Severe: slope	Severe: sandy; slope.	Severe: sandy; slope.	Severe: sandy; slope.
Ratings are for both Boyer and Oshtemo soils in BtA, BtB, BtC, BtD, BtE, and BtF					
Brady: BuA	Moderate: seasonal high water table.	Moderate: sandy	Moderate: sandy	Moderate: sandy	Moderate: sandy.
Breckenridge: Bv	Severe: seasonal high water table; poor drainage.	Severe: poor drainage.	Severe: poor drainage.	Severe: poor drainage.	Severe: poor drainage.
Bronson: BwA	Slight	Moderate: sandy	Moderate: sandy	Moderate: sandy	Moderate: sandy.
Brookston: By	Severe: seasonal high water table; poor drainage.	Severe: poor drainage; moderately slow permeability.	Severe: poor drainage; moderately slow permeability.	Severe: poor drainage.	Severe: poor drainage.
Carlisle: Cc	Severe: seasonal high water table; poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.
Colwood: Cr	Severe: seasonal high water table; poor drainage; unstable.	Severe: poor drainage.	Severe: poor drainage.	Severe: poor drainage.	Severe: poor drainage.
*Conover:					
CvA, CxA. For Miami part of CxA, see the Miami series.	Moderate: seasonal high water table.	Moderate: moderately slow permeability.	Moderate: seasonal high water table; moderately slow permeability.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
CvB	Moderate: seasonal high water table.	Moderate: moderately slow permeability; slope.	Moderate: seasonal high water table; moderately slow permeability.	Moderate: seasonal high water table.	Moderate: seasonal high water table.

TABLE 7.—*Limitations of soils for recreational uses*—Continued

Soil series and map symbols	Service buildings in recreational areas	Play areas	Camp areas	Picnic areas	Paths and trails
Edwards: Ed	Severe: seasonal high water table; unstable; poor drainage.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.
*Fox:					
FoA	Slight	Slight	Slight	Slight	Slight.
FoB, FrB	Slight	Moderate: slope	Slight	Slight	Slight.
FoC, FrC	Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope	Slight.
FrD, FrE	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
FrF	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
For Boyer part of FrB, FrC, FrD, FrE, and FrF, see units having similar slopes under the Boyer series.					
Gilford: Gd	Severe: seasonal high water table; poor drainage.	Severe: poor drainage.	Severe: poor drainage.	Severe: poor drainage.	Severe: poor drainage.
*Hillsdale:					
HdB, HlB, HmB	Slight	Moderate: slope	Slight	Slight	Slight.
HdC, HlC, HmC	Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope	Slight.
HlD, HlE	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
For Miami part of HmB and HmC, see units having similar slopes under the Miami series.					
Houghton: Ho	Severe: seasonal high water table; unstable; poor drainage.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.
Lamson: Lc	Severe: seasonal high water table; unstable; poor drainage.	Severe: poor drainage.	Severe: poor drainage.	Severe: poor drainage.	Severe: poor drainage.
Linwood: Lm	Severe: seasonal high water table; unstable; poor drainage.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.
Locke: LoB	Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Metamora: MlB	Moderate: seasonal high water table.	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Metea:					
MnA	Slight	Slight	Slight	Slight	Slight.
MnB	Slight	Moderate: slope	Slight	Slight	Slight.
MnC	Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope	Slight.
*Miami:					
MoA	Slight	Slight	Slight	Slight	Slight.
MoB, MrB	Slight	Moderate: slope	Slight	Slight	Slight.
For Conover part of MrB, see the Conover series.					
MoC	Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope	Slight.
MoD, MoE	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
MoF	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.

TABLE 7.—*Limitations of soils for recreational uses*—Continued

Soil series and map symbols	Service buildings in recreational areas	Play areas	Camp areas	Picnic areas	Paths and trails
*Minoa: MwB For Thetford part, see Thetford series.	Severe: seasonal high water table; unstable.	Moderate: seasonal high water table; slope.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Oakville: OaB, OkB	Slight	Moderate: slope; sandy.	Moderate: sandy.	Moderate: sandy.	Moderate: sandy.
Oshtemo. Mapped only in complexes with Boyer soils. See Boyer series for ratings.					
Ottokee:					
OlA	Slight	Moderate: sandy.	Moderate: sandy.	Moderate: sandy.	Moderate: sandy.
OlB	Slight	Moderate: sandy; slope.	Moderate: sandy.	Moderate: sandy.	Moderate: sandy.
*Owosso:					
OmA	Slight	Slight	Slight	Slight	Slight.
OmB	Slight	Moderate: slope	Slight	Slight	Slight.
OmC	Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope	Slight.
OmD	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
For Miami part of OmA, OmB, OmC, and OmD, see units having similar slopes under the Miami series.					
Pewamo: Pc	Severe: seasonal high water table; poor drainage.	Severe: poor drainage; moderately slow permeability.	Severe: poor drainage; moderately slow permeability.	Severe: poor drainage.	Severe: poor drainage.
Rifle: Rf	Severe: seasonal high water table; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.
Sebewa: Se	Severe: seasonal high water table; poor drainage.	Severe: poor drainage.	Severe: poor drainage.	Severe: poor drainage.	Severe: poor drainage.
*Spinks:					
SvB	Slight	Moderate: slope; sandy.	Moderate: sandy	Moderate: sandy	Moderate: sandy.
SvC	Moderate: slope	Severe: slope; sandy.	Moderate: sandy	Moderate: sandy	Moderate: sandy.
SvD, SvE	Severe: slope	Severe: slope; sandy.	Severe: slope; sandy.	Severe: slope; sandy.	Moderate: slope: sandy.
SvF	Severe: slope	Severe: slope; sandy.	Severe: slope; sandy.	Severe: slope; sandy.	Severe: slope: sandy.
Ratings apply to both Spinks and Oakville soils.					
Tawas: Tm	Severe: seasonal high water table; unstable; poor drainage.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.
Thetford: Mapped only in a complex with Minoa soils. See Minoa series for ratings.					

TABLE 7.—*Limitations of soils for recreational uses*—Continued

Soil series and map symbols	Service buildings in recreational areas	Play areas	Camp areas	Picnic areas	Paths and trails
Warners: Wc	Severe: seasonal high water table; unstable; poor drainage.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.	Severe: poor drainage; unstable.
Wasepi: WeA	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Washtenaw: Wh	Severe: seasonal high water table; poor drainage.	Severe: poor drainage; silty.	Severe: poor drainage.	Severe: poor drainage.	Severe: poor drainage.

Formation and Classification of the Soils[6]

The first part of this section tells how the factors of soil formation have affected the development of soils in Livingston County. The second part explains the system of soil classification and places each soil series in some of the categories of the system.

Terms common in the current classification system that are used in this section are defined in the Glossary at the back of this survey or in the reference "Soil Classification, a Comprehensive System" and its supplements (*5*).

Factors of Soil Formation

Soil is developed by soil-forming processes acting on materials deposited or accumulated by geologic agents. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the parent material.

Climate and plant and animal life are active factors of soil formation. They act on the parent material and slowly change it to a natural body of soil that has genetically related layers called horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Generally, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is the unconsolidated mass from which a soil is formed. The parent materials of the soils of Livingston County were deposited by glaciers or by melt water from the glaciers, which covered the county from about 10,000 to 12,000 years ago. Some of these materials have been reworked and redeposited by subsequent actions of water and wind. Parent material determines the limits of the chemical and mineralogical composition of the soil. Although parent materials are of common glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited. The dominant parent materials in Livingston County were deposited as glacial till, outwash deposits, lacustrine deposits, alluvium, and organic material.

Glacial till is material laid down directly by glaciers with a minimum of water action. It consists of particles of different sizes that are mixed together. The small pebbles in glacial till have sharp corners, indicating that they have not been worn by water washing. The glacial till in Livingston County is calcareous and is friable or firm. Its texture is sandy loam, loam, silty clay loam, and clay loam. The Miami series is an example of soils that formed in glacial till. These soils are loamy and have a well-developed structure.

Outwash materials are deposited by running water from melting glaciers. The size of the particles that make up outwash material varies according to the speed of the stream of water that carried them. When the water slows down, the coarser particles are deposited. Finer particles, such as very fine sand, silt, and clay, can be carried by slowly moving water. Outwash deposits generally consist of layers of particles of similar size, such as sandy loam. Sand, gravel, and other coarse particles are dominant. Fox soils, for example, formed in deposits of outwash materials in Livingston County.

Lacustrine materials are deposited in still, or ponded, glacial melt water. Because the coarser fragments drop out of moving water as outwash, only the finer particles, such as very fine sand, silt, and clay, remain to settle out in still water. In Livingston County, soils that formed in

[6] R. W. JOHNSON, soil scientist, and H. R. SINCLAIR, JR., assistant State soil scientists, Soil Conservation Service, assisted in preparing this section.

lacustrine deposits are loamy textured. The Lamson series is an example of soils that formed in lacustrine materials.

Alluvium is material deposited by the floodwater of present streams in recent time. This material varies in texture, depending on the speed of the water from which it was deposited.

Organic material is made up of deposits of plant remains. After the glaciers withdrew from the area, water was left standing in depressions on outwash, lake, and till plains. Grasses and sedges growing around the edges of these lakes died, and their remains fell to the bottom. Because of the wetness of the areas, the plant remains did not decompose. Later, white-cedar and other water-tolerant trees grew in the areas. As these trees died, their residues became a part of the organic accumulation. The lakes were eventually filled with organic material and developed into areas of muck and peat. In some of these areas, the plant remains subsequently decomposed. In other areas, the material has changed little since deposition. Soils of the Houghton series are an example of soils that formed in organic material.

Plants and animals

Plants have been the principal organisms influencing the soils in Livingston County; however, bacteria, fungi, earthworms, and the activities of man have also been important. The chief contribution of plants and animal life is the addition of organic matter and nitrogen to the soil. The kind of organic material on and in the soil depends on the kinds of plants that grew on the soil. The remains of these plants accumulate on the surface; they decay and eventually become organic matter. Roots of the plants provide channels for downward movement of water through the soil and also add organic matter as they decay. Bacteria in the soil help to break down the organic matter so that it can be used by growing plants.

The vegetation in Livingston County was mainly deciduous forests. Differences in natural soil drainage and minor changes in parent material have affected the composition of the forest species.

In general, the well-drained soils on uplands, such as the Hillsdale and Miami soils, were mainly covered with maple, elm, ash, hickory, white oak, and red oak. A few wet soils also had sphagnum and other mosses, which contributed substantially to the accumulation of organic matter. The Houghton and Carlisle soils developed under wet conditions and contain considerable organic matter. Thus, the soils of Livingston County that developed under dominantly forest vegetation generally have less total accumulated organic matter than soils that developed under dominantly grass vegetation.

Climate

Climate is important in the formation of soils. It determines the kind of plant and animal life on and in the soil. It determines the amount of water available for weathering of minerals and the transporting of soil materials. Through its influence on temperatures in the soil, climate determines the rate of chemical reaction that occurs in the soil. These influences are important, but they affect large areas rather than a relatively small area, such as a county.

The climate in Livingston County is cool and humid. This is presumably similar to that which existed when the soils were being formed. The soils in Livingston County differ from soils that formed in a dry, warm climate or from those that formed in a hot, moist climate. Climate is uniform throughout the county, although its effect is modified locally by micro-relief. Therefore, the differences in the soils of Livingston County, to a minor extent, are the results of the differences in climate.

Relief

Relief, or topography, has a marked influence on the soils of Livingston County through its influence on natural drainage, erosion, plant cover, and soil temperature. In Livingston County the soils range from level to very steep. Natural soil drainage ranges from well drained on the ridgetops to very poorly drained in the depressions.

Relief influences the formation of soils by affecting runoff and drainage. Drainage, in turn, through its effect on soil aeration, determines the color of the soil. Runoff is greatest on the steeper slopes, but in low areas, water is temporarily ponded. Water and air move freely through soils that are well drained but slowly through soils that are very poorly drained. In soils that are well aerated, the iron and aluminum compounds that give most soils their color are brightly colored and oxidized. In poorly aerated soils the color is dull gray and mottled. The Hillsdale series consists of well-drained, well-aerated soils, whereas the Barry series consists of poorly aerated, very poorly drained soils.

Time

Time, usually a long time, is required by the agents of soil formation to form distinct horizons in the soil from parent material. The differences in the length of time that the parent materials have been in place are commonly reflected in the degree of development of the soil profile. Some soils develop rapidly, others slowly.

The soils in Livingston County range from young to mature. The glacial deposits from which many of the soils in Livingston County formed have been exposed to soil-forming factors for a long enough time to allow distinct horizons to develop within the soil profile. Some soils, however, forming in recent alluvial sediments, have not been in place long enough for distinct horizons to develop.

The Barry and Lamson soils provide examples of the effect of time on the leaching of lime from the soil. The solum of the Barry and Lamson soils had about the same amount of lime as the C horizon of these soils has today. The Lamson soils were submerged under glacial lake water and protected from leaching. In contrast, the Barry soils were above water and subject to leaching. The difference in length of time of leaching is reflected in the Barry soils, which are leached of lime to a depth of 34 inches. On the other hand, the Lamson soils are effervescent at a depth of 18 inches.

Genesis and Morphology of Soils

The processes or soil-forming factors responsible for the development of the soil horizons from the unconsolidated parent material are referred to as soil genesis.

The physical, chemical, and biological properties of the various soil horizons are termed morphology.

Several processes were involved in the formation of soil horizons in the soils of Livingston County. These processes are (1) accumulation of organic matter, (2) leaching of lime (calcium carbonate) and other bases, (3) reduction and transfer of iron, and (4) formation and translocation of silicate clay materials. In most soils of Livingston County, more than one of these processes have been active in the development of the horizons.

Organic matter has accumulated at the surface to form an A1 horizon. The A1 horizon is mixed into a plow layer (Ap horizon) when the soil is plowed. The soils of Livingston County have a surface horizon ranging in organic-matter content from high to low. The Colwood series consists of soils that have a high organic-matter content in the surface layer, but the Oakville soils have a low organic-matter content.

Leaching of carbonates and other bases has occurred in most of the soils. Soil scientists generally agree that leaching of bases in soils usually precedes translocation of silicate clay minerals. Many of the soils are moderately to strongly leached, and this contributed to the development of horizons. For example, the Barry soils are leached of carbonates to a depth of 34 inches, but the Lamson soils are leached to a depth of only 18 inches. The differences in the depth of leaching are a result of the effect of time as a soil-forming factor.

Reduction and transfer of iron, a process called gleying, is evident in the somewhat poorly drained to very poorly drained soils. The gray color in the subsoil horizons indicates the reduction and loss of iron. Pewamo soils show evidence of gleying and the reduction processes. Some horizons contain mottles and indicate a segregation of iron. This process has taken place in Locke and Minoa soils.

In some soils the translocation of clay minerals has contributed to horizon development. The eluviated (leached) A2 horizon above the illuviated (accumulated) B horizon has a platy structure, is lower in content of clay, and generally is lighter in color. The B horizon normally has an accumulation of clay (clay films) in pores and on surfaces of peds. These soils were probably leached of carbonates and soluble salts to a considerable extent before translocation of silicate clay took place. Leaching of bases and translocation of silicate clays are among the more important processes in horizon differentiation in the soils. The Hillsdale soils are examples of soils that have translocated silicate clays accumulated in the B horizon in the form of clay films.

Classification of the Soils

Soils are classified so that their significant characteristics can be more easily remembered. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us understand their behavior and their response to manipulation. First through classification and then through the use of soil maps we can apply our knowledge of soils to small specific areas or to large tracts of land.

The Comprehensive Classification System, the system currently used, was adopted by the National Cooperative Soil Survey in 1965 (*5*). This system is under continual study. Therefore, readers interested in new developments and revision of this soil classification system should consult the latest available literature.

The current system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. The six categories of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings to soils. The two exceptions, the Entisols and Histosols, may occur in many different climates.

Table 8 shows the soil orders that are in Livingston County. These are Alfisols, Entisols, Histosols, Inceptisols, and Mollisols.

Entisols are recent soils; they lack genetic horizons or have only the beginnings of such horizons.

Inceptisols most commonly are on young but not recent land surfaces.

Alfisols are soils that have a clay-enriched B horizon that is high in base saturation.

Mollisols are soils that have a thick, dark-colored surface layer.

The Histosols are soils that developed in organic material. They include soils commonly called mucks, peats, organic soils, or bogs.

SUBORDER. Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterloggings, or soil differences resulting from the climate or vegetation. Examples of suborders are Aquepts and Udalfs.

GREAT GROUPS. Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated or those that have pans that interfere with the growth of roots or movement of water. The features used are some properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like.

SUBGROUPS. Great groups are subdivided into subgroups, one representing the central concept of the group and others called intergrades and extragrades. Intergrade subgroups have properties of the group and also one or more properties of another great group, suborder, or order. Extragrade subgroups have properties of the group and have characteristics that are not diagnostic

TABLE 8.—*Classification of soil series into higher categories* [1]

Soil series	Family	Subgroup	Order
Arkport [2]	Coarse-loamy, mixed, mesic	Psammentic Hapludalfs	Alfisols.
Barry	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Berville	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Boyer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Brady [2]	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Breckenridge [2]	Coarse-loamy, mixed, nonacid, frigid	Mollic Haplaquepts	Inceptisols.
Bronson [2]	Coarse-loamy, mixed, mesic	Aquic Hapludalfs	Alfisols.
Brookston [2]	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Carlisle [2]	Euic, mesic	Typic Medisaprists	Histosols.[3]
Colwood [2]	Fine-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Conover	Fine-loamy, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Edwards	Marly, euic, mesic	Limnic Medisaprists	Histosols.[3]
Fox	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols.
Gilford [2]	Coarse-loamy, mixed, mesic	Typic Haplaquolls	Mollisols'
Hillsdale	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Houghton	Euic, mesic	Typic Medisaprists	Histosols.[3]
Lamson [2]	Coarse-loamy, mixed, nonacid, mesic	Aeric Haplaquepts	Inceptisols.
Linwood	Loamy, mixed, euic, mesic	Terric Medisaprists	Histosols.[3]
Locke	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Metamora	Fine-loamy, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Metea	Fine-loamy, mixed, mesic	Arenic Hapludalfs	Alfisols.
Miami	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Minoa [2]	Coarse-loamy, mixed, frigid	Aquic Dystric Eutrochrepts	Inceptisols.
Oakville	Mixed, mesic	Typic Udipsamments	Entisols.
Oshtemo [2]	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Ottokee	Mixed, mesic	Alfic Udipsamments	Entisols.
Owosso	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Pewamo	Fine, mixed, mesic	Typic Argiaquolls	Mollisols.
Rifle [2]	Euic	Typic Borohemists	Histosols.[3]
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Argiaquolls	Mollisols.
Spinks	Sandy, mixed, mesic	Psammentic Hapludalfs	Alfisols.
Tawas [2]	Sandy or sandy-skeletal, mixed, euic	Terric Borosaprists	Histosols.[3]
Thetford	Sandy, mixed, mesic	Aquic Arenic Hapudalfs	Alfisols.
Warners	Fine-silty, mixed (calcareous), mesic	Typic Haplaquolls	Mollisols.
Wasepi [2]	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Washtenaw	Fine-loamy, mixed, nonacid, mesic	Typic Haplaquents	Entisols.

[1] Classification is as of March 1971. Placement of series in the current system, particularly in families, could change as more precise information is available.

[2] These soils are taxadjuncts to the series for which they are named. They are outside the defined range for the series for the following reasons:

Arkport.—The B and C horizons are finer textured.
Brady.—The upper part of the profile is dominantly coarser textured and low-chroma mottles are deeper in the profile.
Breckenridge.—Annual temperature is a few degrees warmer. Also, the loamy sand and sand in these soils are not in the defined range.
Bronson.—The upper part of the solum is coarser textured.
Brookston.—The Ap horizon is thinner.
Carlisle.—The subhorizon is brighter colored.
Colwood.—The C horizon is finer textured.
Gilford.—The first subhorizon is less gray.
Lamson.—The C horizon is finer textured, and the B horizon is dominantly grayer.
Minoa.—The B and C horizons are brighter colored, and effervescent soil material is closer to the surface.
Oshtemo.—The upper subhorizons are coarser textured.
Rifle.—Annual soil temperature is a few degrees warmer, and the upper part of the soils is more acid.
Tawas.—Annual soil temperature is a few degrees warmer.
Wasepi.—The first subhorizon is less gray.

[3] These soils are presently classified as Histosols for the purpose of information only. The profiles in some respects do not support the current classification.

of another great group, suborder, or order. Examples of subgroup names are Typic Hapludalfs for the central concept, Mollic Haplaquepts for an intergrade, and Aeric Haplaquepts for an extragrade.

FAMILIES. Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, depth, slope, consistence, and coatings. A family name consists of a series of adjectives that are the class names for texture, mineralogy, and so on. These are used to differentiate families. An example is the fine, mixed, mesic family.

SERIES. The series is a group of soils that have major horizons that, except for the texture of the surface layer, are similar in important characteristics and in arrangement of the profile. They are commonly given the name of a geographic location near the place where that series was first observed and mapped.

In table 8, each soil series in Livingston County is placed into some of the categories of the classification system.

General Nature of the County

This section provides information about the climate and some farm statistics.

Cimate [7]

Because of the inland location of Livingston County in southeastern Michigan, the effect of the Great Lakes is not so readily noticed in this county as in many other areas of the State. The main lake effect in Livingston County is the higher percentage of cloudiness late in fall and early in winter, when prevailing westerly winds move cold air across the warmer lake water. However, a 5 to 10 percent increase in the annual percentage of possible sunshine can be expected in the county as compared to a similar location in the western part of Michigan. Table 9 shows temperature and precipitation data for Livingston County, and table 10 gives probabilities of the last freezing temperature in spring and the first in fall.

Available weather data show that the highest temperature ever recorded at Milford, in Oakland County, was 104° F. on July 24, 1934, and the lowest was −20° on February 9, 1934. Data from Milford are considered representative for Livingston County. An average of 5 days in winter have temperatures falling to zero or lower. At the other extreme, a temperature of 100° or higher occurs in only about one summer out of 10, and 90° or higher occurs on an average of 10 days during summer.

The highest monthly mean temperature on record is 76.0° in July 1955, and the lowest is 12.0° in February 1934. The average dates of the last freezing temperature in spring and the first in fall are May 10 and October 6, respectively.

[7] By Norton D. Strommen, climatologist for Michigan, National Weather Service, U.S. Department of Commerce.

Precipitation is heaviest during the growing months or crop season. It averages 59 percent of the annual total during the 6 months from April through September. The greatest average monthly precipitation is 3.76 inches and occurs in May. The greatest amount of precipitation ever received in a 1-month period was 10.66 inches in October 1954. The smallest average monthly precipitation is 1.32 inches and is in January. As much as 1.2 inches of precipitation in 1 hour, 1.5 inches in 2 hours, and 2.4 inches in 24 hours falls about once in 2 years. In 24 hours 3.6 inches fall about once in 10 years and 4.4 inches fall about once in 50 years.

Evaporation data from the Dearborn station, about 30 miles southeast of Livingston County, indicate an average evaporation total of 43.04 inches from April to October. This is nearly twice the normal rainfall total of 22.40 inches for the same 6-month period. The water supply of the soil is recharged in winter and early in spring. The capacity of the soil to hold this moisture to supplement the summer rainfall, when the water demands are high, is important for successful farming in this area.

Snowfall averages 42.6 inches a year, but it varies considerably from year to year. Totals in the last 30 years have varied from as much as 66.4 inches in the 1951–52 season to as little as 21.3 inches in the 1936–37 season. Measurable amounts of snow usually fall during each month from November through April.

Cloudiness is greatest late in fall and early in winter and is least late in spring and in summer. Records at Flint, which is the nearest 24-hour station of the National Weather Service, show that December averages 22

TABLE 9.—*Temperature and precipitation*

[Data from Milford, Oakland County, for the period 1932–61]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average monthly total	One year in 10 will have—		Average number of days with 1 inch or more of snow	Average depth of snow on days with snow cover
			Maximum temperature equal to or higher than—	Minimum temperature equal to or higher than—		Less than—	More than—		
	° F.	° F.	° F.	° F.	Inches	Inches	Inches		Inches
January	30.3	16.6	46	0	1.96	0.7	3.5	18	3.7
February	31.6	16.0	47	0	2.12	.8	3.8	18	4.5
March	40.8	23.6	61	8	2.58	1.4	3.9	8	3.7
April	54.8	34.8	75	22	3.44	1.7	5.3	1	1.8
May	67.2	45.6	83	33	3.76	1.7	6.2	----------	2.0
June	77.3	56.0	89	45	3.40	1.7	5.4	0	0
July	82.1	60.1	90	49	2.75	.8	5.0	0	0
August	80.5	59.1	91	49	3.34	1.6	5.6	0	0
September	72.4	51.6	88	38	2.99	.8	5.5	0	0
October	60.7	41.7	77	28	2.72	.8	5.0	(1)	1.0
November	44.4	30.0	62	16	2.42	1.2	3.8	4	2.6
December	32.8	20.0	50	3	2.09	1.0	3.3	15	3.0
Year	56.2	37.9	[2] 95	[3] −6	33.57	24.4	43.3	64	3.7

[1] Less than one-half day.
[2] Average annual maximum.
[3] Average annual minimum.

TABLE 10.—*Probabilities of last freezing temperatures in spring and first in fall*

[Data from Milford, Oakland County, for the period 1932–61]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	April 3	April 16	April 24	May 10	May 25
2 years in 10 later than	March 29	April 11	April 19	May 5	May 20
5 years in 10 later than	March 19	April 1	April 9	April 25	May 10
Fall:					
1 year in 10 earlier than	November 12	November 3	October 22	October 8	September 22
2 years in 10 earlier than	November 17	November 8	October 27	October 13	September 27
5 years in 10 earlier than	November 28	November 19	November 7	October 24	October 8

cloudy days, 7 partly cloudy days, and 2 clear days, July records show 10 cloudy days, 13 partly cloudy days, and 8 clear days.

Farming

The total land area of Livingston County is about 365,440 acres. Of this, about 48 percent, or 174,047 acres, is in farms (7). The rest consists mainly of State land, privately owned woodland, abandoned farmland, and resort, urban, recreational, and industrial areas. Of the acreage in farms in 1969, 71,810 acres were in harvested crops and 16,496 acres were in cropland used only for pasture.

There were 1,099 farms in the county in 1969. Of these farms, 250 were from 1 to 49 acres in size, 227 were from 50 to 99 acres, 432 were from 100 to 259 acres, 157 were from 260 to 499 acres, and 28 were from 500 to 999 acres. Only five farms were larger than 1,000 acres.

Corn is the chief row crop grown, and in 1969, 19,418 acres of corn were harvested for grain and 8,061 acres were cut for silage. Small grain also is important in the county, and in 1969, there were 6,418 acres of wheat, 4,333 acres of oats, 48 acres of barley, and 412 acres of rye. Only 723 acres of soybeans were harvested. Of the hay crops harvested, 17,001 acres were alfalfa and alfalfa mixtures and 2,349 acres were clover and timothy. Potatoes were grown on 23 acres; beans on 32 acres; tree fruits, nuts, and grapes on 671 acres; and vegetables harvested for sale on 443 acres.

Literature Cited

(1) AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2v., illus. Washington, D.C.

(2) MICHIGAN DEPARTMENT OF STATE HIGHWAYS.
1970. FIELD MANUAL OF SOIL ENGINEERING. Ed. 5, 474 pp., illus.

(3) MICHIGAN STATE UNIVERSITY.
1966. FERTILIZER RECOMMENDATIONS FOR VEGETABLES AND FIELD CROPS IN MICHIGAN. Ext. Bul. E. 550, 24 pp.

(4) UNITED STATES DEPARTMENT OF AGRICULTURE.
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handbook 18, 503 pp., illus. [Supplement issued in May 1962]

(5) ———
1960. SOIL CLASSIFICATION, A COMPREHENSIVE SYSTEM, 7TH APPROXIMATION. 265 pp., illus., [Supplements issued in March 1967 and in September 1968].

(6) ———
1966. LAND-CAPABILITY CLASSIFICATION. U.S. Dept. Agr. Handbook 210, 21 pp.

(7) UNITED STATES DEPARTMENT OF COMMERCE.
1967. 1964 UNITED STATES CENSUS OF AGRICULTURE; STATISTICS FOR THE STATE AND COUNTIES, MICHIGAN. Vol. 1, 419 pp.

(8) UNITED STATES DEPARTMENT OF DEFENSE.
1968. UNIFIED SOIL CLASSIFICATION SYSTEM FOR ROADS, AIRFIELDS, EMBANKMENTS AND FOUNDATIONS. MIL-STD-619B, 30 pp., illus.

Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Coarse fragments. Mineral or rock particles more than 2 millimeters in diameter.

Cobblestone. A rounded or partly rounded fragment of rock, 3 to 10 inches in diameter.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to the terrace grade.

Contour stripcropping. Growing crops in strips that follow the contour or are parallel to terraces or diversions. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cover crop. A close-growing crop grown primarily to improve the soil and to protect it between periods of regular crop production.

Diversion. Channel constructed across the slope for the purpose of intercepting runoff.

Drainage, artificial. The removal of excess water on or within the soil by means of surface or subsurface drains.

Drainage, natural. Refers to the conditions that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. The following five classes of natural drainage are recognized in Livingston County.

Well-drained soils are nearly free from mottling and are commonly of medium or coarse texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum; they have uniform color in the A horizon and the upper part of the B horizon and are mottled in the lower part of the B horizon and in the C horizon.

Somewhat poorly drained soils are wet for significant periods but not all the time; the water table is within 12 to 24 inches of the surface during part of the year; mottling occurs at a depth below 6 to 16 inches, in the lower part of the A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods; they are light gray and generally are mottled from the surface downward but may be free of mottling or nearly so.

Very poorly drained soils are wet nearly all the time; they have a dark-gray or black surface layer and are black, gray, or light gray, with or without mottling, in the lower part of the profile.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Glaciofluvial deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice; the deposits are stratified and occur in the form of kames, eskers, deltas, and outwash plains.

Gravel. Rounded pebbles 2 millimeters to 3 inches in diameter. A gravelly soil is 15 to 50 percent gravel.

Green manure. A crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

Habitat. The environment in which the life needs of a plant, bird, or animal are supplied.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residue.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Landscape. All the natural features (fields, hills, forests, water, etc.) that distinguish one part of the earth's surface from another part; usually an area that the eye can comprehend in a single view.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Micronutrient. A chemical element needed in very small amounts for growth of plants. Boron, copper, iron, manganese, and zinc are examples. "Micro" refers to amount needed, not to essentiality.

Mineral soil. Soil composed mainly of inorganic (mineral) material and low in content of organic matter. Its bulk density is greater than that of an organic soil.

Minimum tillage. The amount of tillage needed to create proper conditions for germination of seed, establishment of plants, and control of competing vegetation.

Mottled. Irregularly marked with spots of a different color. Mottles vary in number and size. Their presence usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: *abundance*—few, common, and many; *size*—fine, medium, and coarse; and *contrast*—faint, distinct, and prominent. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to about 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Muck. An organic soil consisting of well-decomposed organic material that is finely divided and dark colored.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color that has a hue of 10YR, a value of 6, and a chroma of 4.

Organic matter. A general term for plant and animal material, in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of rapid decomposition.

Organic soil. A general term applied to a soil or to a soil horizon that consists primarily of organic matter, such as peat soils, muck soils, and peaty soil layers.

Overgrazing. Grazing so heavy as to impair future forage production and to cause deterioration of plants or soils or both.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Peat. Unconsolidated soil material, largely undecomposed organic matter that has accumulated where there has been excess moisture.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Percolation. The downward movement of water through soil.

Piping. Removal of soil material through subsurface flow channels (pipes) formed by seepage water.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike

those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. As used in this survey, that part of the A horizon that is directly below the surface layer. It is leached of soluble minerals and clay.

Surface layer. As used in this survey, that part of the A horizon that occurs at the surface. This layer contains an accumulation of organic matter and generally is dark colored.

Taxadjuncts. Soils in some way unlike the soils of the series by whose name they are identified but enough like those soils in morphology, composition, and behavior so that little would be gained by establishing a new series.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

Valley train. A long, narrow body of outwash confined within a valley.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Woodland. Land used primarily for growing trees and shrubs. In addition to what is ordinarily called forest or forest plantations, it includes shelterbelts, windbreaks, wide hedgerows of plants that supply food and cover for wildlife, and streambanks and other slopes that have woodland cover.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit or a woodland suitability group, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:

Acreage and extent, table 1, page 6.
Predicted yields, table 2, page 45.
Wildlife, table 3, page 50.
Engineering uses of the soils, tables 4, 5, and 6, pages 56 through 79.
Recreational uses, table 7, page 82.

Map symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page	Woodland suitability group Symbol	Woodland suitability group Page
Ad	Alluvial land	7	Vw-1 (L-2c)	43	---	--
ApA	Arkport fine sandy loam, 0 to 2 percent slopes	7	IIIs-3 (3a)	42	3s5	47
ApB	Arkport fine sandy loam, 2 to 6 percent slopes	7	IIIs-4 (3a)	42	3s5	47
ApC	Arkport fine sandy loam, 6 to 12 percent slopes	7	IIIe-9 (3a)	41	3s5	47
Ba	Barry sandy loam	8	IIw-6 (3c)	40	4w3	48
Be	Berville loam	9	IIw-8 (3/2c)	40	4w3	48
Bp	Borrow pits	9	VIIIs-1	44	---	--
BrA	Boyer loamy sand, 0 to 2 percent slopes	10	IIIs-3 (4a)	42	3s5	47
BrB	Boyer loamy sand, 2 to 6 percent slopes	10	IIIs-4 (4a)	42	3s5	47
BrC	Boyer loamy sand, 6 to 12 percent slopes	10	IIIe-9 (4a)	41	3s5	47
BsA	Boyer loamy sand, silty substratum, 0 to 2 percent slopes	10	IIIs-3 (4a)	42	3s5	47
BsB	Boyer loamy sand, silty substratum, 2 to 6 percent slopes	10	IIIs-4 (4a)	42	3s5	47
BtA	Boyer-Oshtemo loamy sands, 0 to 2 percent slopes	10	IIIs-3 (4a)	42	3s5	47
BtB	Boyer-Oshtemo loamy sands, 2 to 6 percent slopes	10	IIIs-4 (4a)	42	3s5	47
BtC	Boyer-Oshtemo loamy sands, 6 to 12 percent slopes	11	IIIe-9 (4a)	41	3s5	47
BtD	Boyer-Oshtemo loamy sands, 12 to 18 percent slopes	11	IVe-9 (4a)	42	3s5	47
BtE	Boyer-Oshtemo loamy sands, 18 to 25 percent slopes	11	VIe-2 (4a)	43	3s6	48
BtF	Boyer-Oshtemo loamy sands, 25 to 35 percent slopes	11	VIIe-2 (4a)	43	3s6	48
BuA	Brady loamy sand, 0 to 2 percent slopes	12	IIIw-5 (4b)	41	3w2	48
Bv	Breckenridge loamy sand	13	IIw-8 (3/2c)	40	4w3	48
BwA	Bronson loamy sand, 0 to 2 percent slopes	13	IIIs-3 (4a)	42	3s5	47
By	Brookston loam	14	IIw-4 (2.5c)	39	3w3	48
Cc	Carlisle muck	14	IIIw-15 (Mc)	41	-w1	48
Cr	Colwood fine sandy loam	15	IIw-4 (2.5c)	39	4w3	48
CvA	Conover loam, 0 to 2 percent slopes	16	IIw-4 (2.5b)	39	3w1	48
CvB	Conover loam, 2 to 6 percent slopes	16	IIw-5 (2.5b)	40	3w1	48
CxA	Conover-Miami loams, 0 to 2 percent slopes	16	IIw-4 (2.5a, 2.5b)	39	---	--
	Conover part	--	------------	--	3w1	48
	Miami part	--	------------	--	2o1	47
Ed	Edwards muck	17	IVw-6 (M/mc)	43	-w1	48
FoA	Fox sandy loam, 0 to 2 percent slopes	17	IIs-2 (3a)	40	2o1	47
FoB	Fox sandy loam, 2 to 6 percent slopes	17	IIe-3 (3a)	39	2o1	47
FoC	Fox sandy loam, 6 to 12 percent slopes	18	IIIe-6 (3a)	41	2o1	47
FrB	Fox-Boyer complex, 2 to 6 percent slopes	18	IIIs-4 (3a, 4a)	42	---	--
	Fox part	--	------------	--	2o1	47
	Boyer part	--	------------	--	3s5	47
FrC	Fox-Boyer complex, 6 to 12 percent slopes	18	IIIe-9 (3a, 4a)	41	---	--
	Fox part	--	------------	--	2o1	47
	Boyer part	--	------------	--	3s5	47
FrD	Fox-Boyer complex, 12 to 18 percent slopes	18	IVe-9 (3a, 4a)	42	---	--
	Fox part	--	------------	--	2o1	47
	Boyer part	--	------------	--	3s5	47
FrE	Fox-Boyer complex, 18 to 25 percent slopes	19	VIe-2 (3a, 4a)	43	---	--
	Fox part	--	------------	--	2o2	47
	Boyer part	--	------------	--	3s6	48
FrF	Fox-Boyer complex, 25 to 40 percent slopes	19	VIIe-2 (3a, 4a)	43	---	--
	Fox part	--	------------	--	2o2	47
	Boyer part	--	------------	--	3s6	48

Map symbol		Page	Capability unit Symbol	Capability unit Page	Woodland suitability group Symbol	Woodland suitability group Page
Gd	Gilford sandy loam	19	IIIw-5 (4c)	40	4w3	48
Gr	Gravel pits	20	VIIIs-1	44	---	--
HdB	Hillsdale loamy sand, 2 to 6 percent slopes	20	IIe-3 (3a)	39	3o3	47
HdC	Hillsdale loamy sand, 6 to 12 percent slopes	21	IIIe-6 (3a)	41	3o3	47
HlB	Hillsdale sandy loam, 2 to 6 percent slopes	21	IIe-3 (3a)	39	3o3	47
HlC	Hillsdale sandy loam, 6 to 12 percent slopes	21	IIIe-6 (3a)	41	3o3	47
HlD	Hillsdale sandy loam, 12 to 18 percent slopes	21	IVe-4 (3a)	42	3o3	47
HlE	Hillsdale sandy loam, 18 to 25 percent slopes	21	VIe-2 (3a)	43	3o4	47
HmB	Hillsdale-Miami loams, 2 to 6 percent slopes	21	IIe-2 (2.5a, 3a)	38	---	--
	Hillsdale part	--	-----------	--	3o3	47
	Miami part	--	-----------	--	2o1	47
HmC	Hillsdale-Miami loams, 6 to 12 percent slopes	21	IIIe-5 (2.5a, 3a)	41	---	--
	Hillsdale part	--	-----------	--	3o3	47
	Miami part	--	-----------	--	2o1	47
Ho	Houghton muck	22	IIIw-15 (Mc)	41	-w1	48
La	Lake beaches	22	VIIIs-1	44	---	--
Lc	Lamson fine sandy loam	23	IIIw-5 (3c)	41	4w3	48
Lm	Linwood muck	23	IIw-10 (M/3c)	40	-w1	48
LoB	Locke sandy loam, 0 to 4 percent slopes	24	IIw-6 (3b)	40	3w1	48
Md	Made land	24	VIIIs-1	44	---	--
MlB	Metamora sandy loam, 0 to 4 percent slopes	25	IIw-8 (3/2b)	40	3w1	48
MnA	Metea loamy sand, 0 to 2 percent slopes	25	IIIs-3 (4/2a)	42	3s5	47
MnB	Metea loamy sand, 2 to 6 percent slopes	25	IIIs-4 (4/2a)	42	3s5	47
MnC	Metea loamy sand, 6 to 12 percent slopes	26	IIIe-9 (4/2a)	41	3s5	47
MoA	Miami loam, 0 to 2 percent slopes	27	IIe-2 (2.5a)	38	2o1	47
MoB	Miami loam, 2 to 6 percent slopes	27	IIe-2 (2.5a)	38	2o1	47
MoC	Miami loam, 6 to 12 percent slopes	27	IIIe-5 (2.5a)	41	2o1	47
MoD	Miami loam, 12 to 18 percent slopes	27	IVe-4 (2.5a)	42	2o1	47
MoE	Miami loam, 18 to 25 percent slopes	27	VIe-2 (2.5a)	43	2o2	47
MoF	Miami loam, 25 to 35 percent slopes	27	VIIe-2 (2.5a)	43	2o2	47
MrB	Miami-Conover loams, 2 to 6 percent slopes	27	IIe-2 (2.5a)	38	---	--
	Miami part	--	-----------	--	2o1	47
	Conover part	--	-----------	--	3w1	48
MwB	Minoa-Thetford complex, 0 to 4 percent slopes	28	IIIw-5 (3b, 4b)	41	---	--
	Minoa part	--	-----------	--	3w1	48
	Thetford part	--	-----------	--	3w2	48
OaB	Oakville fine sand, 0 to 6 percent slopes	29	IVs-4 (5a)	43	3s5	47
OkB	Oakville fine sand, loamy substratum, 0 to 6 percent slopes	29	IVs-4 (5/2a)	43	3s5	47
OlA	Ottokee loamy sand, 0 to 2 percent slopes	30	IIIs-3 (5a)	42	3s5	47
OlB	Ottokee loamy sand, 2 to 6 percent slopes	30	IIIs-4 (5a)	42	3s5	47
OmA	Owosso-Miami sandy loams, 0 to 2 percent slopes	31	IIs-2 (2.5a, 3/2a)	40	2o1	47
OmB	Owosso-Miami sandy loams, 2 to 6 percent slopes	31	IIe-3 (2.5a, 3/2a)	39	2o1	47
OmC	Owosso-Miami sandy loams, 6 to 12 percent slopes	31	IIIe-6 (2.5a, 3/2a)	41	2o1	47
OmD	Owosso-Miami sandy loams, 12 to 18 percent slopes	31	IVe-4 (2.5a, 3/2a)	42	2o1	47
Pc	Pewamo clay loam	32	IIw-2 (1.5c)	39	3w3	48
Rf	Rifle muck	32	IIIw-15 (Mc)	41	-w1	48
Se	Sebawa loam	33	IIw-6 (3c)	40	3w3	48

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page	Woodland suitability group Symbol	Woodland suitability group Page
SvB	Spinks-Oakville loamy sands, 0 to 6 percent slopes	33	IIIs-3 (4a, 5a)	42	3s5	47
SvC	Spinks-Oakville loamy sands, 6 to 12 percent slopes	33	IIIe-9 (4a, 5a)	41	3s5	47
SvD	Spinks-Oakville loamy sands, 12 to 18 percent slopes	34	IVe-9 (4a, 5a)	42	3s5	47
SvE	Spinks-Oakville loamy sands, 18 to 25 percent slopes	34	VIe-2 (4a, 5a)	43	3s6	48
SvF	Spinks-Oakville loamy sands, 25 to 35 percent slopes	34	VIIe-2 (4a, 5a)	43	3s6	48
Tm	Tawas muck	34	IVw-5 (M/4c)	42	-w1	48
Wc	Warners loam	35	IVw-6 (M/mc)	43	-w1	48
WeA	Wasepi sandy loam, 0 to 2 percent slopes	36	IIIw-5 (4b)	41	3w2	48
Wh	Washtenaw silt loam	37	IIw-4 (L-2c)	39	3w3	48

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457–3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

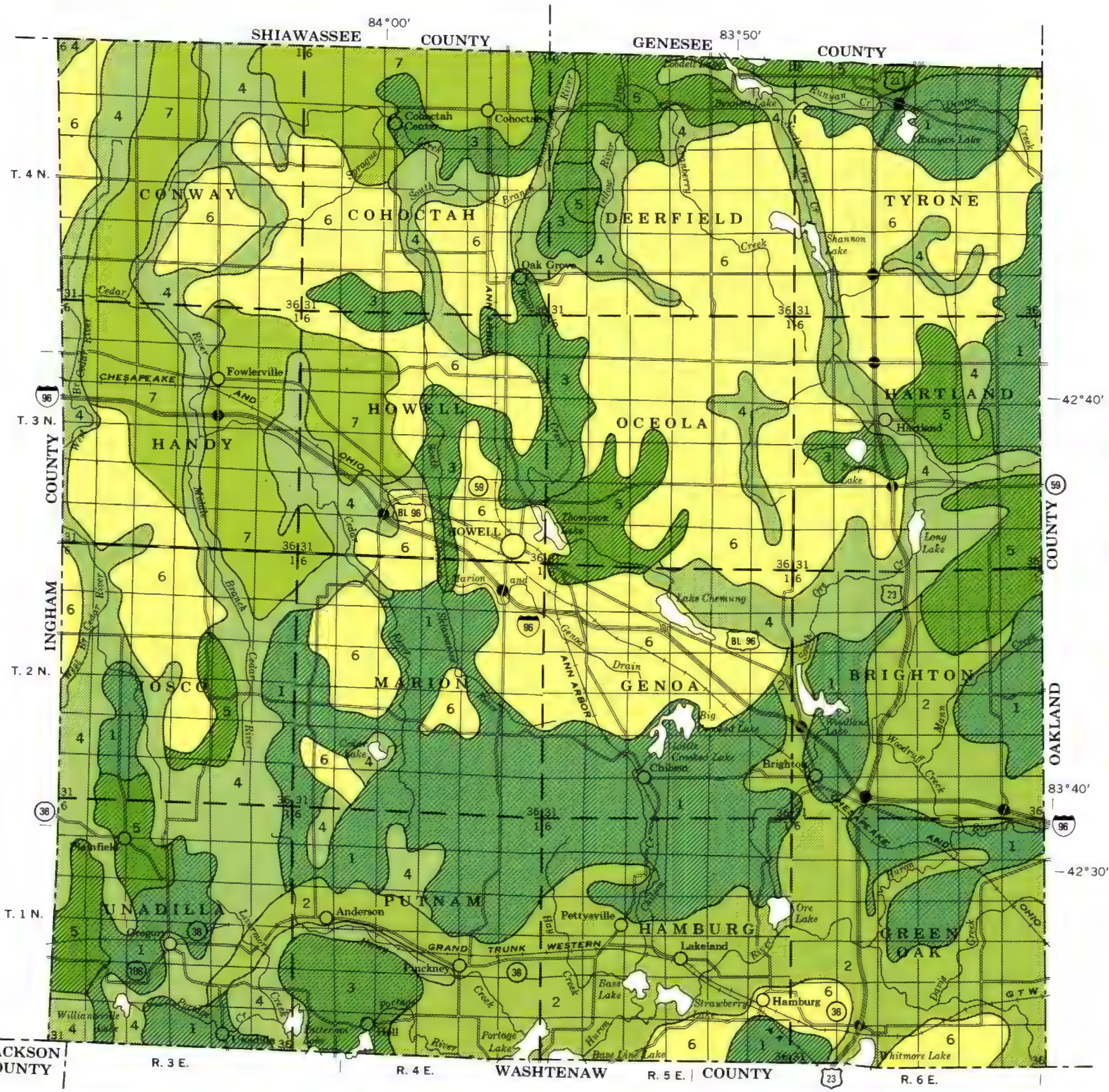
The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers. If you believe you experienced discrimination when obtaining services from USDA, participating in a USDA program, or participating in a program that receives financial assistance from USDA, you may file a complaint with USDA. Information about how to file a discrimination complaint is available from the Office of the Assistant Secretary for Civil Rights. USDA prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex (including gender identity and expression), marital status, familial status, parental status, religion, sexual orientation, political beliefs, genetic information, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.)

To file a complaint of discrimination, complete, sign, and mail a program discrimination complaint form, available at any USDA office location or online at www.ascr.usda.gov, or write to:

USDA
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, S.W.
Washington, DC 20250-9410

Or call toll free at (866) 632-9992 (voice) to obtain additional information, the appropriate office or to request documents. Individuals who are deaf, hard of hearing, or have speech disabilities may contact USDA through the Federal Relay service at (800) 877-8339 or (800) 845-6136 (in Spanish). USDA is an equal opportunity provider, employer, and lender.

Persons with disabilities who require alternative means for communication of program information (e.g., Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MICHIGAN AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

LIVINGSTON COUNTY, MICHIGAN

Scale 1:190,080

1 0 1 2 3 4 Miles

SOIL ASSOCIATIONS *

1 Fox-Boyer-Oshtemo association: Steep or hilly, well-drained, moderately coarse textured and coarse textured soils on moraines

2 Fox-Boyer-Oshtemo-Houghton association: Nearly level to steep, well-drained, moderately coarse textured and coarse textured soils and very poorly drained organic soils on outwash plains

3 Spinks-Oakville-Boyer-Oshtemo association: Strongly sloping to hilly, well-drained, coarse-textured soils dominantly on moraines

4 Carlisle-Houghton-Gilford association: Nearly level, very poorly drained, organic soils and moderately coarse textured soils on outwash plains, in glacial drainageways, and on lake plains

5 Miami-Hillsdale association: Strongly sloping to hilly, well-drained, medium-textured and moderately coarse textured soils on moraines and till plains

6 Miami-Conover association: Nearly level to strongly sloping, well-drained and somewhat poorly drained, medium-textured soils on till plains and moraines

7 Miami-Brookston association: Nearly level to gently sloping, well-drained and poorly drained, medium-textured soils on till plains

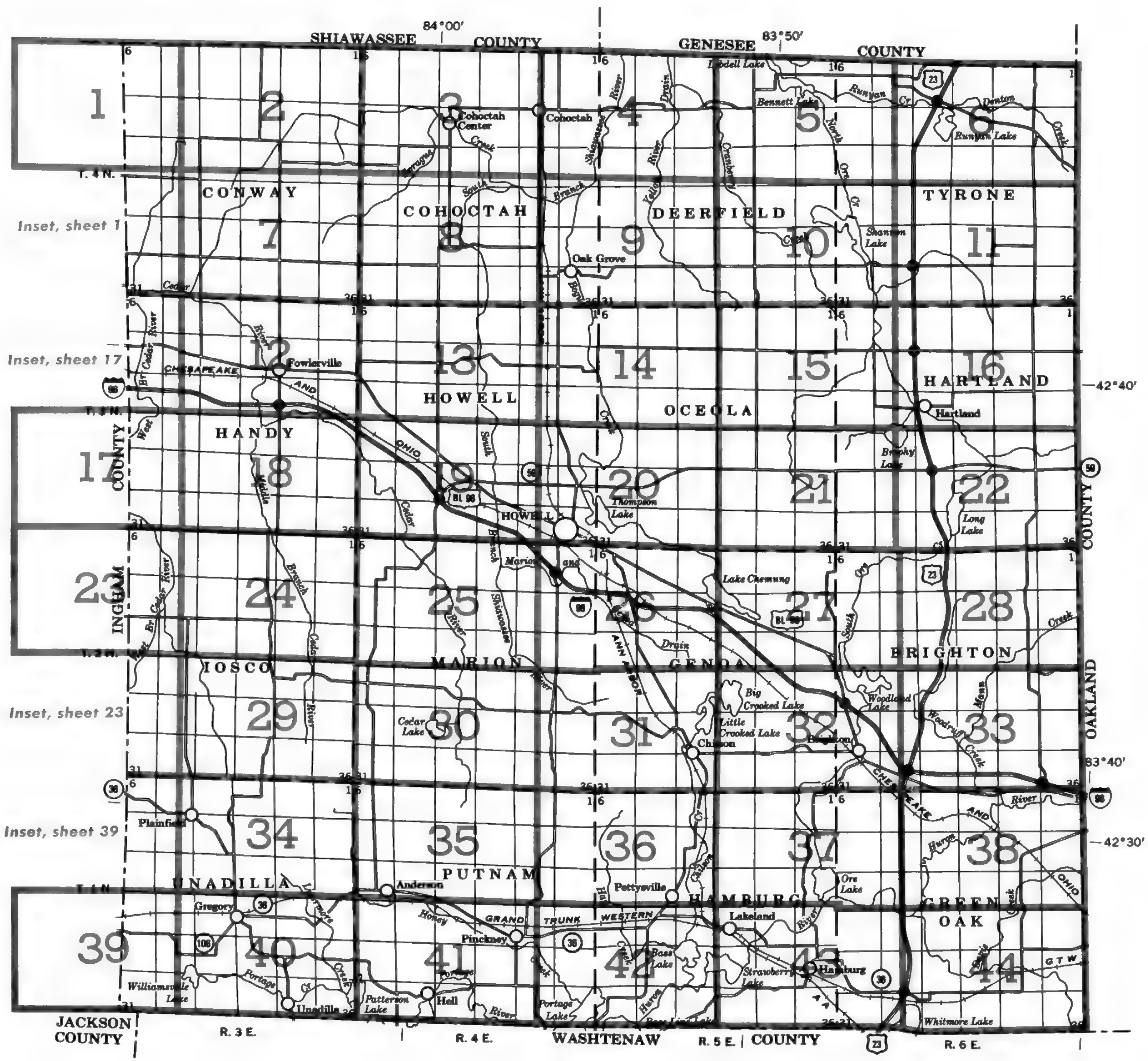
* Texture refers to the surface layer of the major soils of each association.

Compiled 1973

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS
LIVINGSTON COUNTY, MICHIGAN

Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry
- Ford
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches

Lakes and ponds
- Perennial
- Intermittent

Spring

Marsh or swamp

Wet spot

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

- Soil boundary and symbol
- Gravel
- Stoniness: Stony; Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully
- Less than 3 acres of well and moderately well drained soil with coarse or moderately coarse textured solum
- Less than 3 acres of somewhat poorly and poorly drained coarse and moderately coarse textured soils with coarse and moderately coarse textured substrata
- Less than 3 acres of organic soil in an area of mineral soil
- Less than 3 acres of mineral soil in an acra of organic soil

SOIL LEGEND

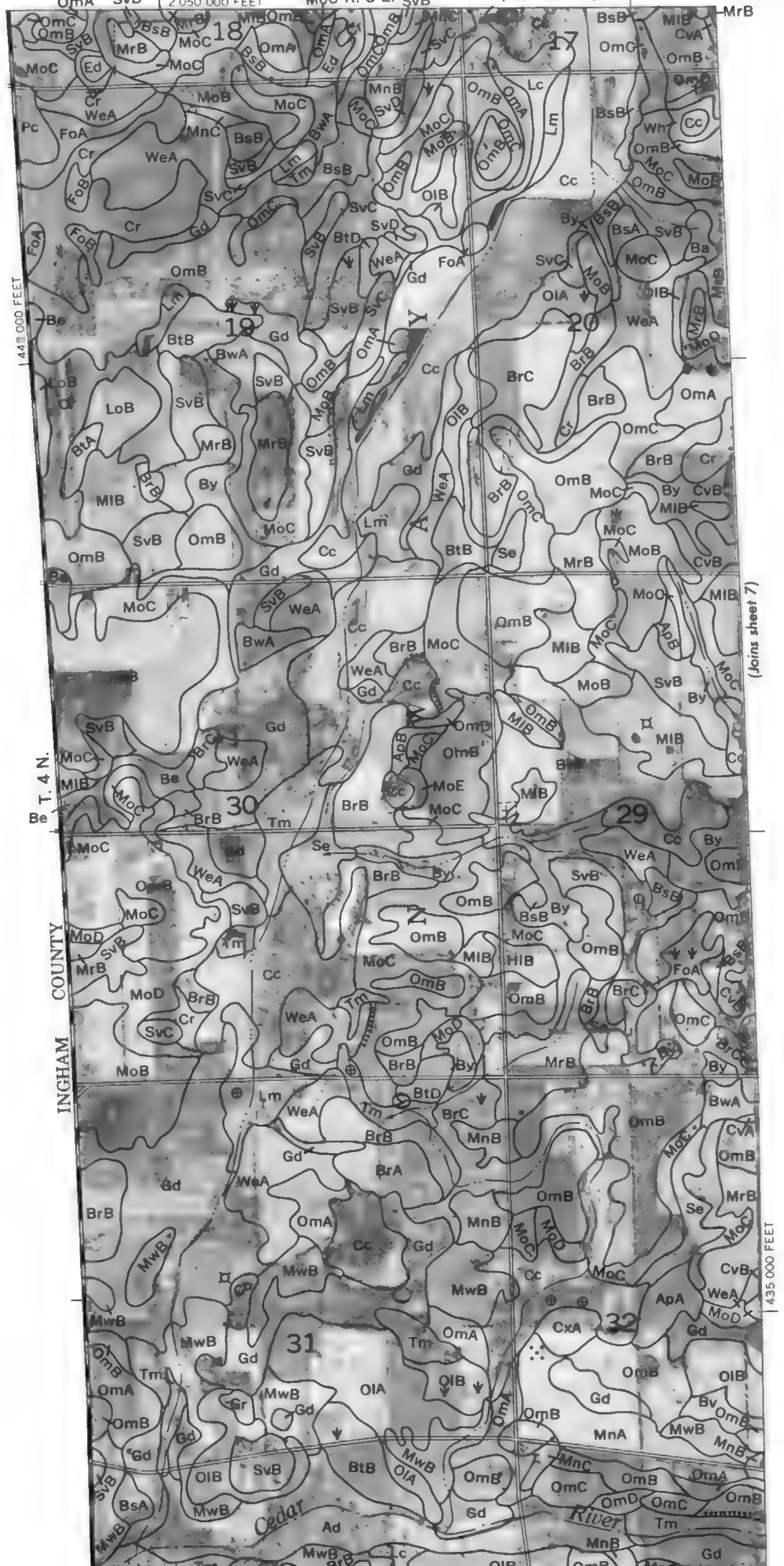
The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F, shows the slope. Most symbols without a slope letter are those of nearly level soils, but some are for land types that have a considerable range of slope.

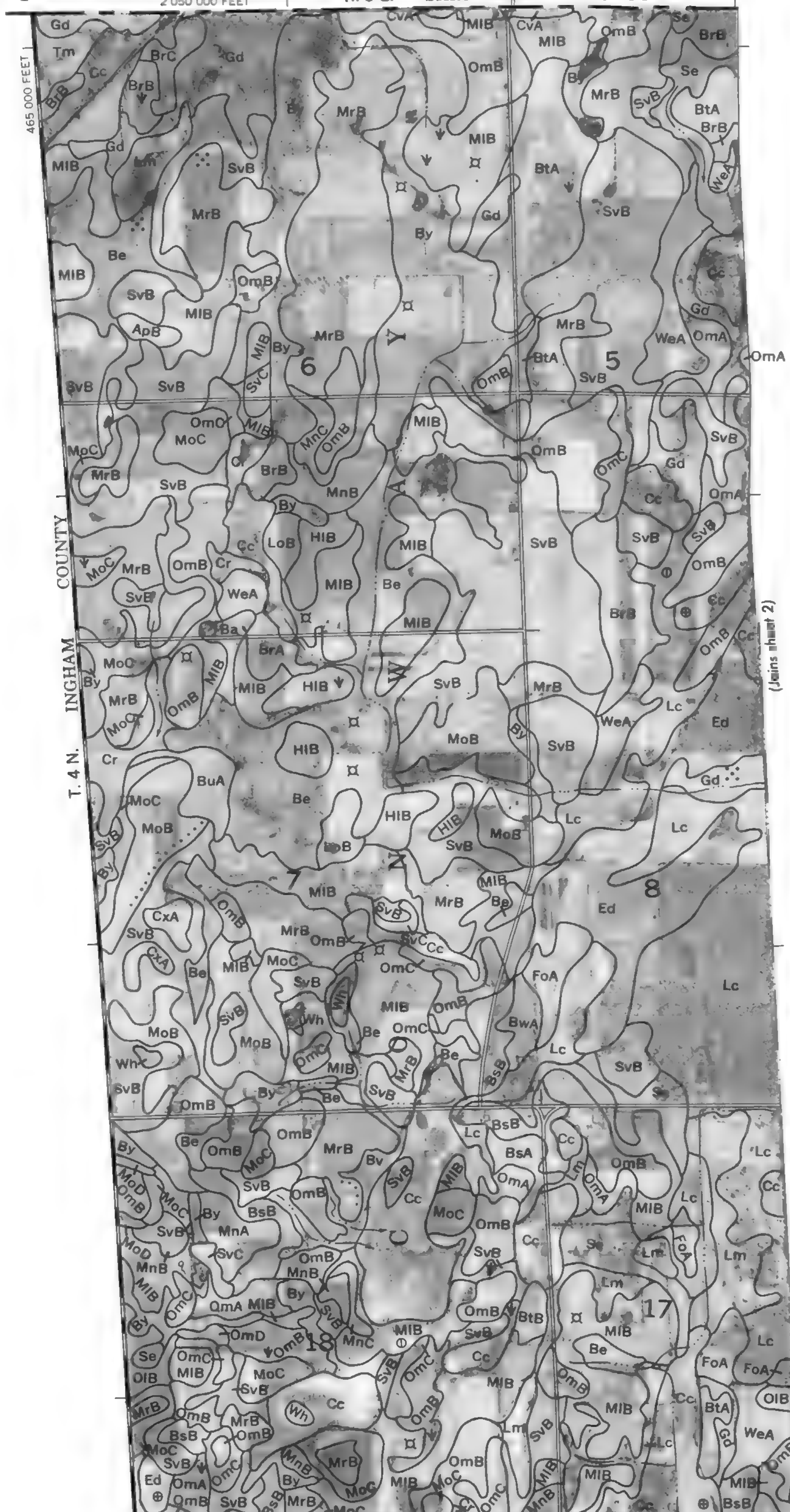
SYMBOL	NAME
Ad	Alluvial land
ApA	Arkport fine sandy loam, 0 to 2 percent slopes
ApB	Arkport fine sandy loam, 2 to 6 percent slopes
ApC	Arkport fine sandy loam, 6 to 12 percent slopes
Ba	Barry sandy loam
Be	Berville loam
Bp	Borrow pits
BrA	Boyer loamy sand, 0 to 2 percent slopes
BrB	Boyer loamy sand, 2 to 6 percent slopes
BrC	Boyer loamy sand, 6 to 12 percent slopes
BsA	Boyer loamy sand, silty substratum, 0 to 2 percent slopes
BsB	Boyer loamy sand, silty substratum, 2 to 6 percent slopes
BtA	Boyer-Oshtemo loamy sands, 0 to 2 percent slopes
BtB	Boyer-Oshtemo loamy sands, 2 to 6 percent slopes
BtC	Boyer-Oshtemo loamy sands, 6 to 12 percent slopes
BtD	Boyer-Oshtemo loamy sands, 12 to 18 percent slopes
BtE	Boyer-Oshtemo loamy sands, 18 to 25 percent slopes
BtF	Boyer-Oshtemo loamy sands, 25 to 35 percent slopes
BuA	Brady loamy sand, 0 to 2 percent slopes
Bv	Breckenridge loamy sand
BwA	Bronson loamy sand, 0 to 2 percent slopes
By	Brookston loam
Cc	Carlisle muck
Cr	Colwood fine sandy loam
CvA	Conover loam, 0 to 2 percent slopes
CvB	Conover loam, 2 to 6 percent slopes
CxA	Conover-Miami loams, 0 to 2 percent slopes
Ed	Edwards muck
FoA	Fox sandy loam, 0 to 2 percent slopes
FoB	Fox sandy loam, 2 to 6 percent slopes
FoC	Fox sandy loam, 6 to 12 percent slopes
FrB	Fox-Boyer complex, 2 to 6 percent slopes
FrC	Fox-Boyer complex, 6 to 12 percent slopes
FrD	Fox-Boyer complex, 12 to 18 percent slopes
FrE	Fox-Boyer complex, 18 to 25 percent slopes
FrF	Fox-Boyer complex, 25 to 40 percent slopes
Gd	Gilford sandy loam
Gr	Gravel pits
HdB	Hillsdale loamy sand, 2 to 6 percent slopes
HdC	Hillsdale loamy sand, 6 to 12 percent slopes
HlB	Hillsdale sandy loam, 2 to 6 percent slopes
HlC	Hillsdale sandy loam, 6 to 12 percent slopes
HlD	Hillsdale sandy loam, 12 to 18 percent slopes
HlE	Hillsdale sandy loam, 18 to 25 percent slopes
HmB	Hillsdale-Miami loams, 2 to 6 percent slopes
HmC	Hillsdale-Miami loams, 6 to 12 percent slopes
Ho	Houghton muck
La	Lake beaches
Lc	Lamson fine sandy loam
Lm	Linwood muck
LoB	Locke sandy loam, 0 to 4 percent slopes
Md	Made land
MlB	Metamora sandy loam, 0 to 4 percent slopes
MnA	Metea loamy sand, 0 to 2 percent slopes
MnB	Metea loamy sand, 2 to 6 percent slopes
MnC	Metea loamy sand, 6 to 12 percent slopes
MoA	Miami loam, 0 to 2 percent slopes
MoB	Miami loam, 2 to 6 percent slopes
MoC	Miami loam, 6 to 12 percent slopes
MoD	Miami loam, 12 to 18 percent slopes
MoE	Miami loam, 18 to 25 percent slopes
MoF	Miami loam, 25 to 35 percent slopes
MrB	Miami-Conover loams, 2 to 6 percent slopes
MwB	Minoa-Thetford complex, 0 to 4 percent slopes
OaB	Oakville fine sand, 0 to 6 percent slopes
OkB	Oakville fine sand, loamy substratum, 0 to 6 percent slopes
OlA	Ottokee loamy sand, 0 to 2 percent slopes
OlB	Ottokee loamy sand, 2 to 6 percent slopes
OmA	Owosso-Miami sandy loams, 0 to 2 percent slopes
OmB	Owosso-Miami sandy loams, 2 to 6 percent slopes
OmC	Owosso-Miami sandy loams, 6 to 12 percent slopes
OmD	Owosso-Miami sandy loams, 12 to 18 percent slopes
Pc	Pewamo clay loam
Rf	Rifle muck
Se	Sebewa loam
SvB	Spinks-Oakville loamy sands, 0 to 6 percent slopes
SvC	Spinks-Oakville loamy sands, 6 to 12 percent slopes
SvD	Spinks-Oakville loamy sands, 12 to 18 percent slopes
SvE	Spinks-Oakville loamy sands, 18 to 25 percent slopes
SvF	Spinks-Oakville loamy sands, 25 to 35 percent slopes
Tm	Tawas muck
Wc	Warners loam
WeA	Wasepi sandy loam, 0 to 2 percent slopes
Wh	Washtenaw silt loam

1

LIVINGSTON COUNTY, MICHIGAN NO. 1

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.

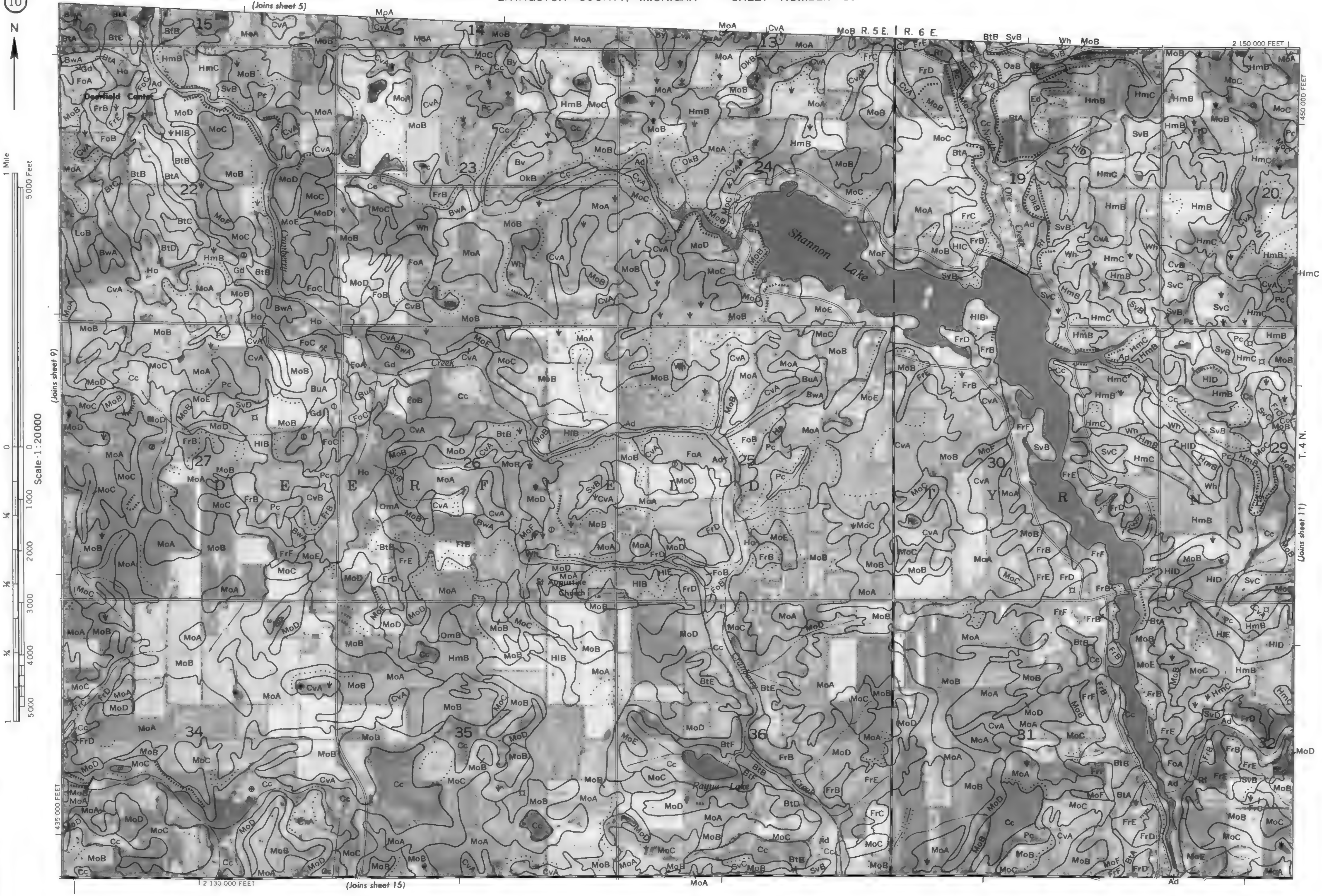




N

1 Mile
5000 Feet
Scale 1:20000
0 1000 2000 3000 4000 5000

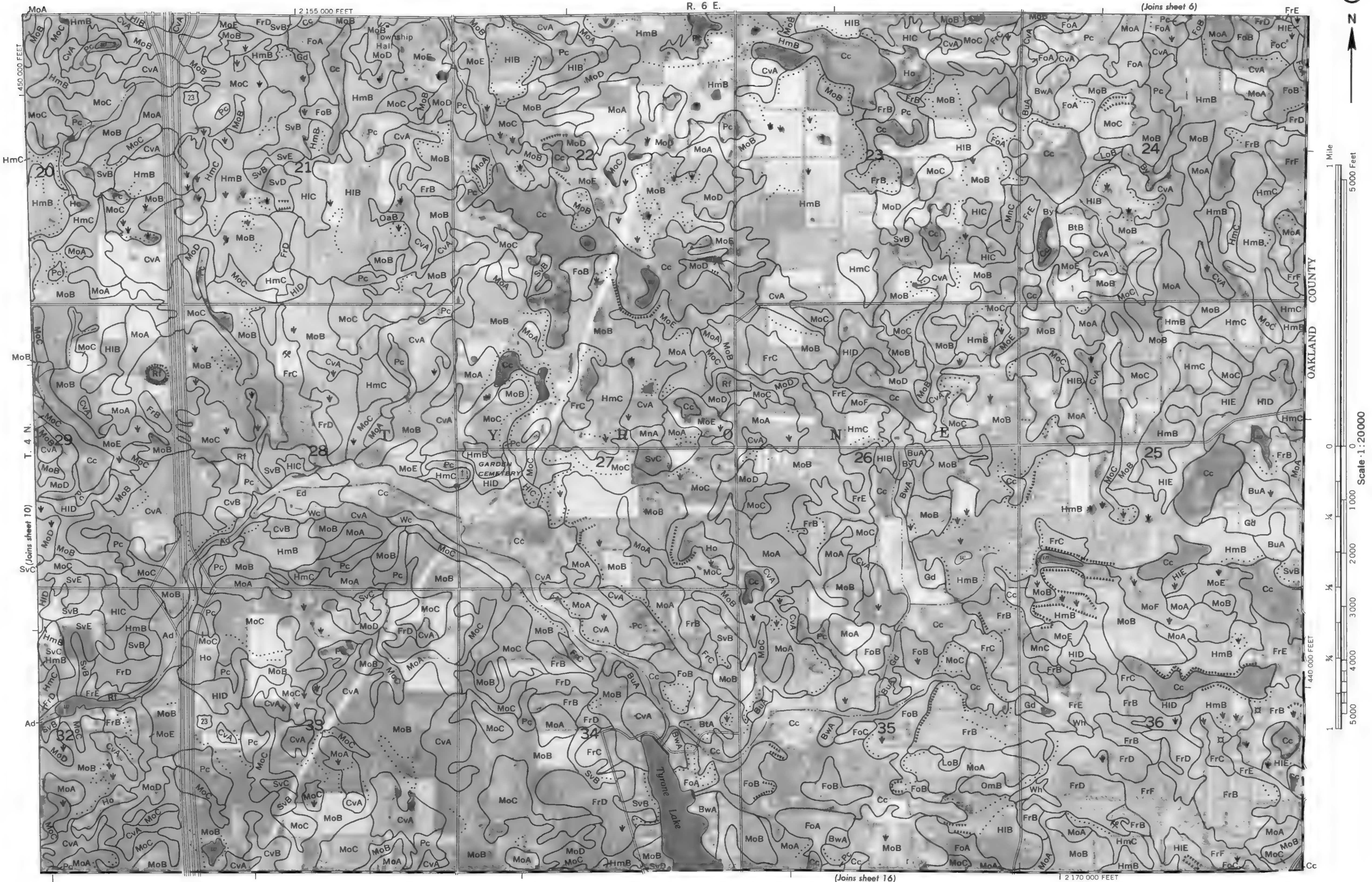
LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 10



Land division corners are approximately positioned on this map.

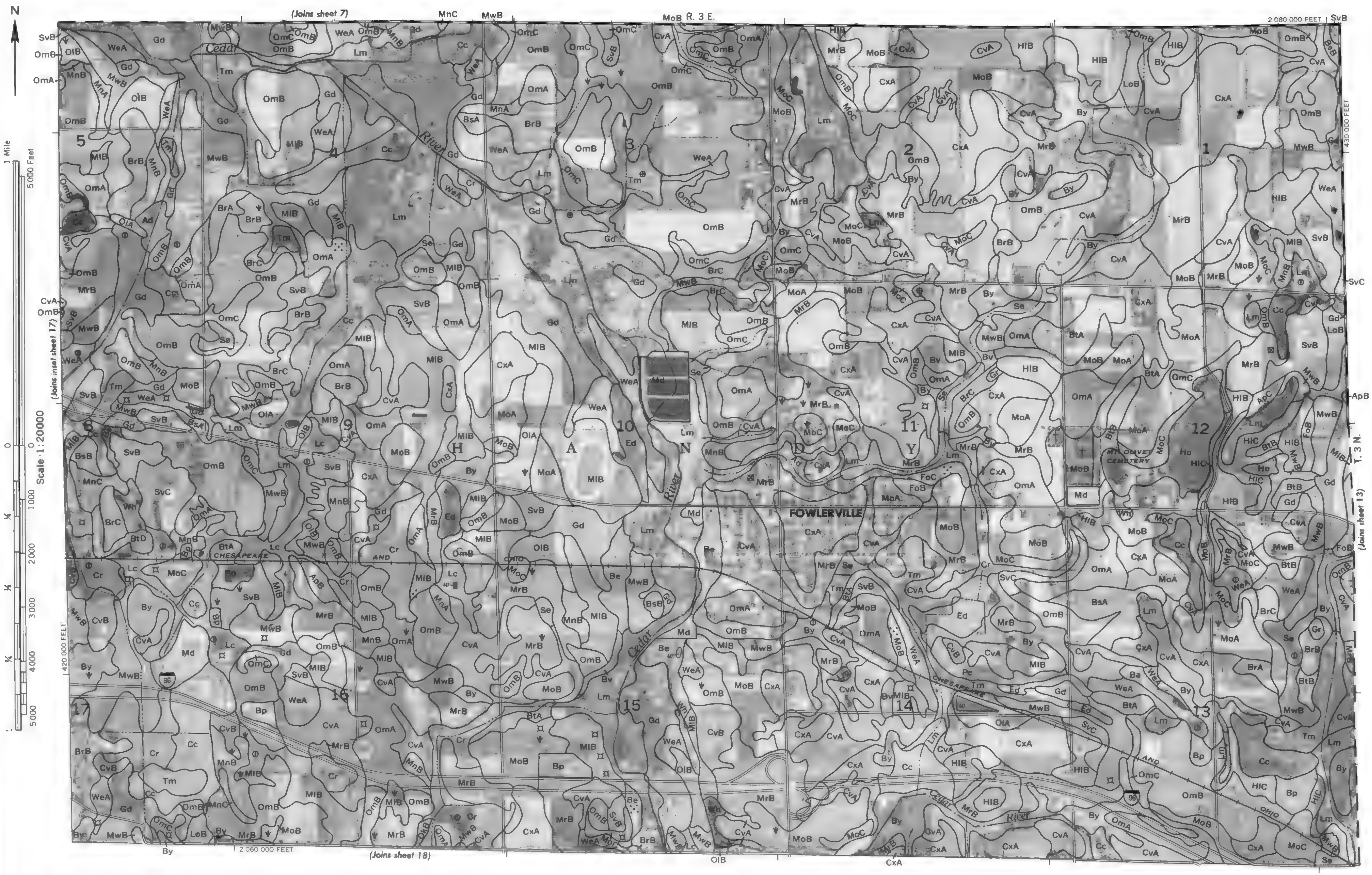
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.



LIVINGSTON COUNTY, MICHIGAN NO. 11

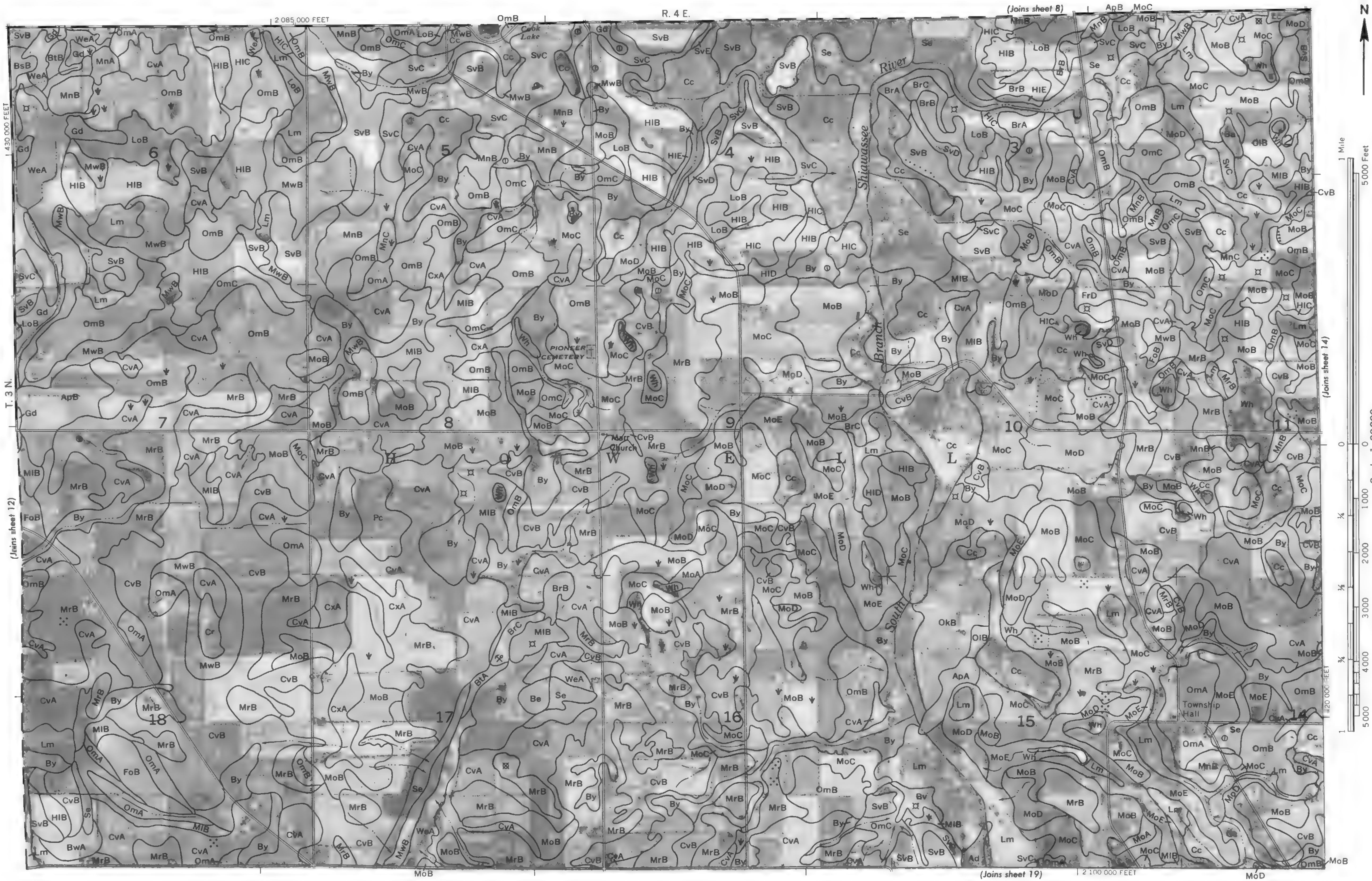
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

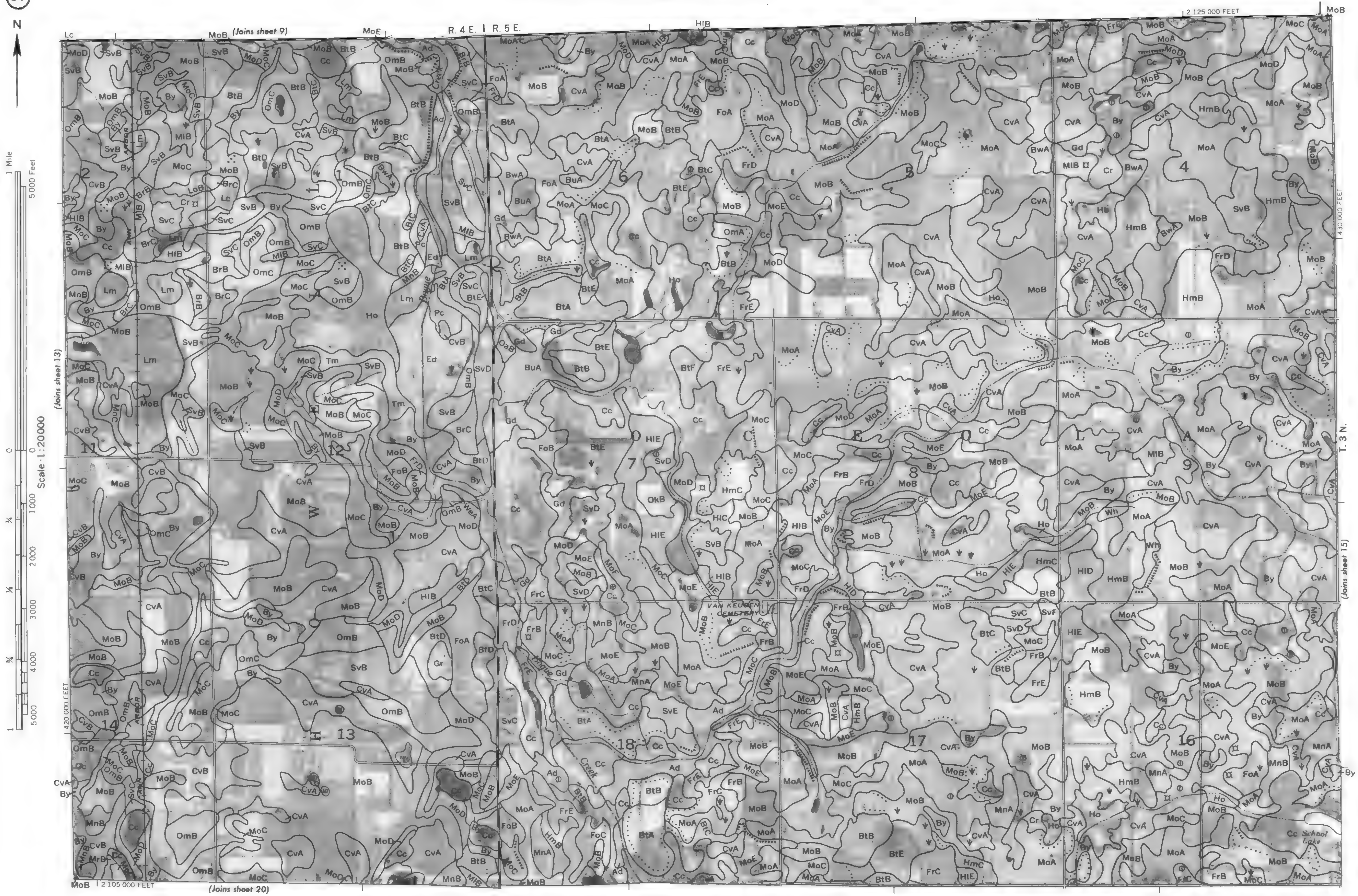
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.



LIVINGSTON COUNTY, MICHIGAN NO. 13

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.

LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 14



Land division corners are approximately positioned on this map.

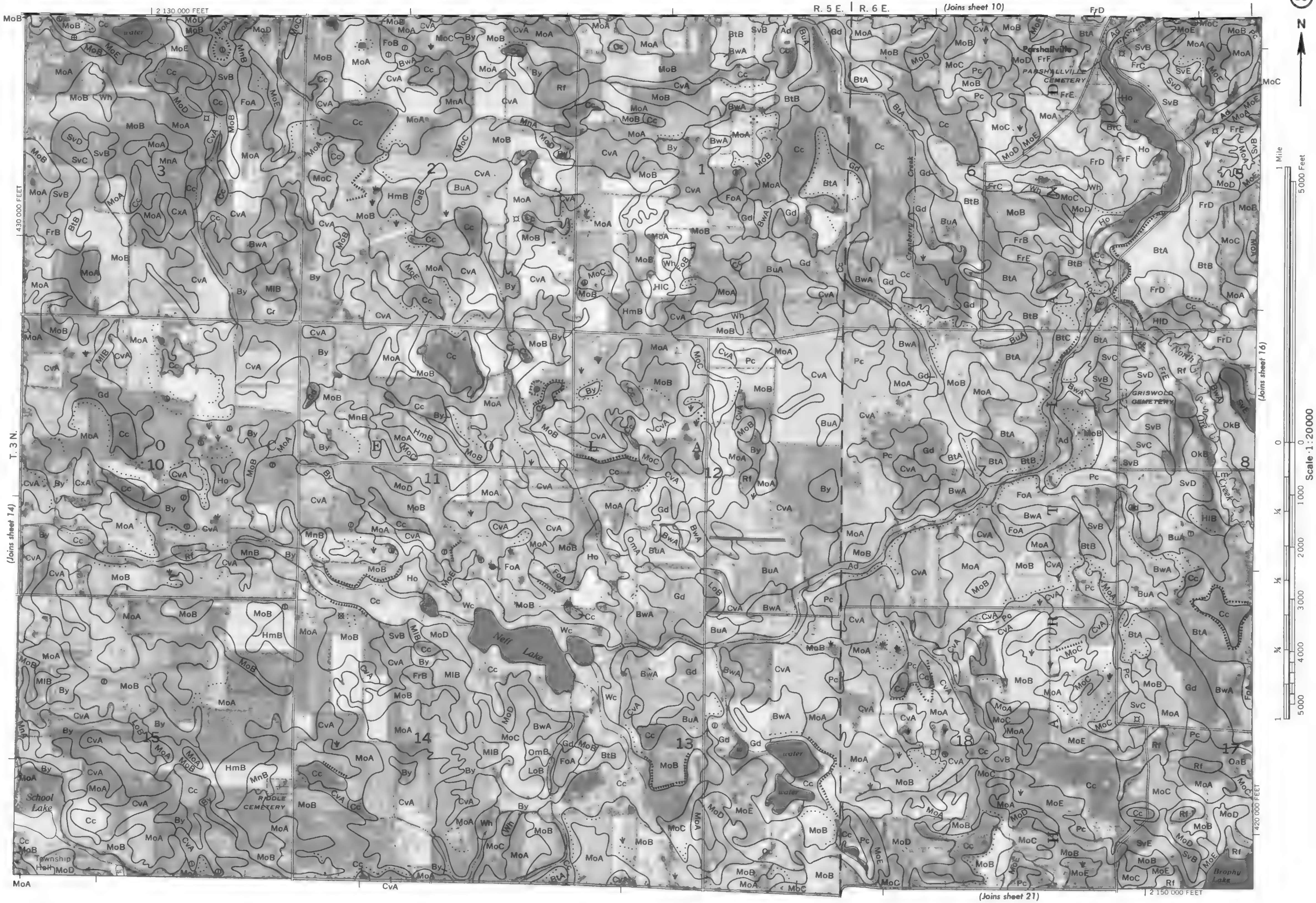
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

15

LIVINGSTON COUNTY, MICHIGAN NO. 15

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.



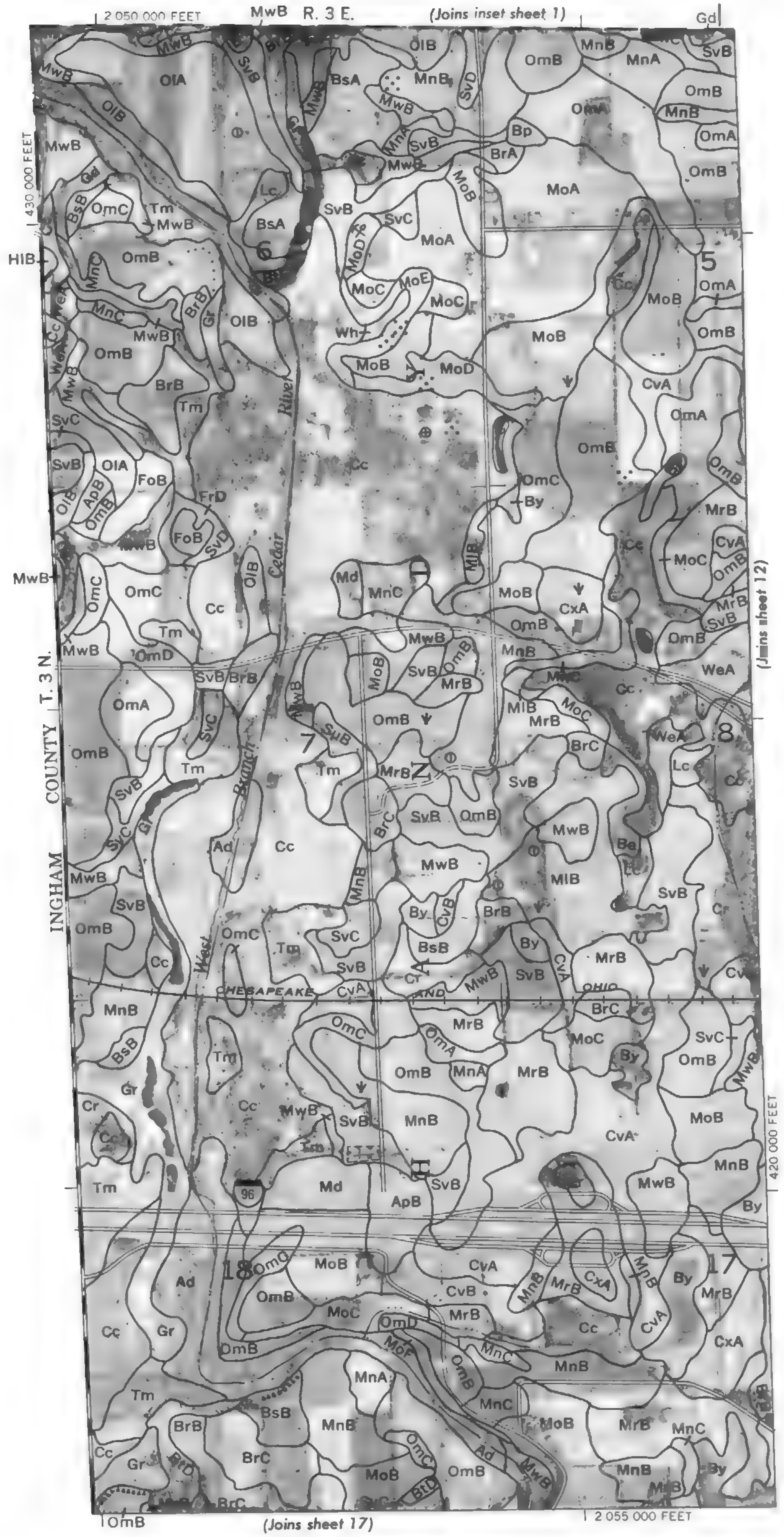
LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 16

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

17



N

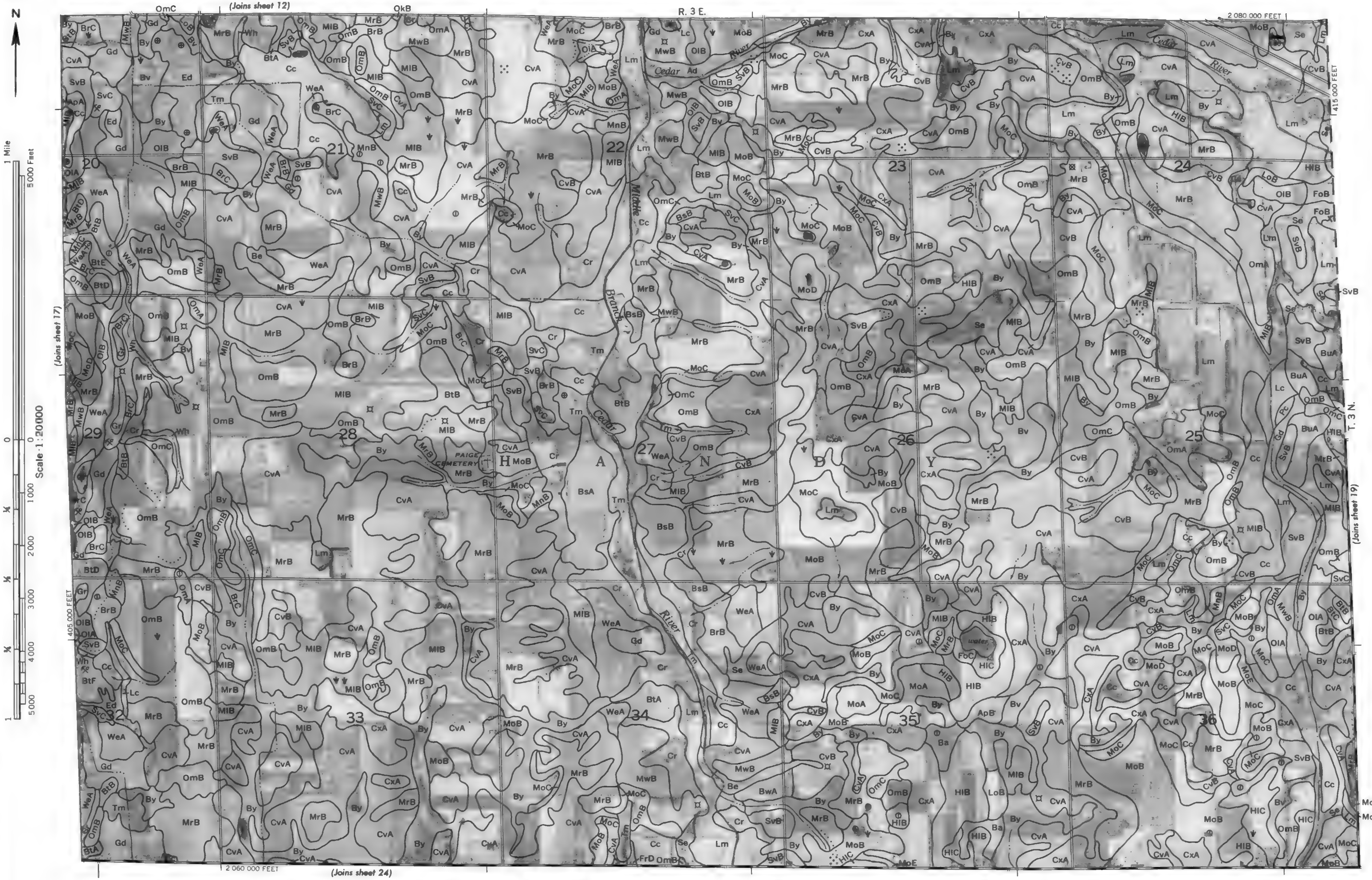
1 Mile
5000 Feet
Scale 1:20000

4000 AND 5000-FOOT GRID TICKS

LIVINGSTON COUNTY, MICHIGAN NO. 17

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone
Land division corners are approximately positioned on this map.

LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 18



Land division corners are approximately positioned on this map.

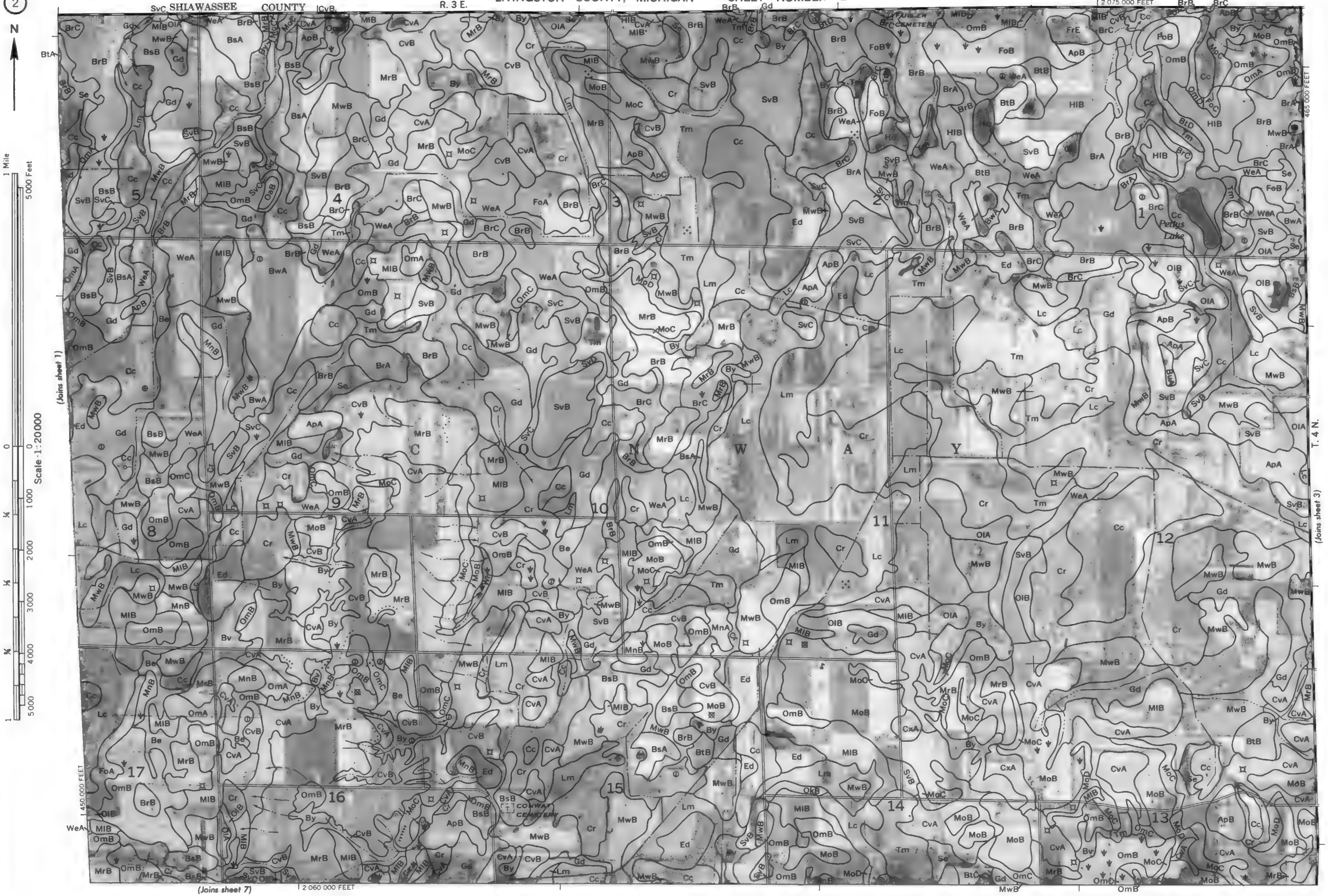
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

LIVINGSTON COUNTY, MICHIGAN NO. 18

LIVINGSTON COUNTY, MICHIGAN NO. 19

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station. Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone. Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

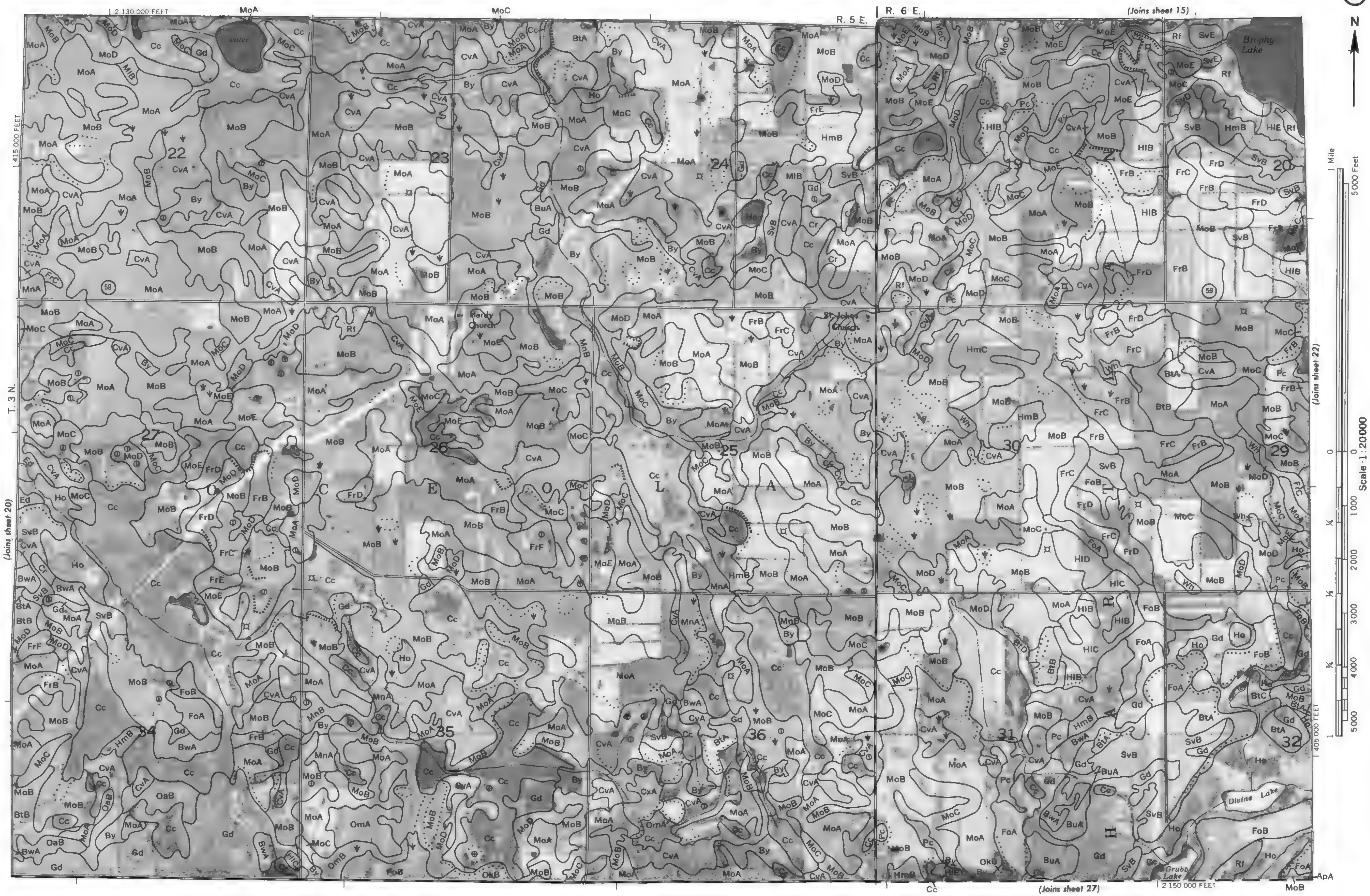
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.



LIVINGSTON COUNTY, MICHIGAN NO. 21

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.

LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 22

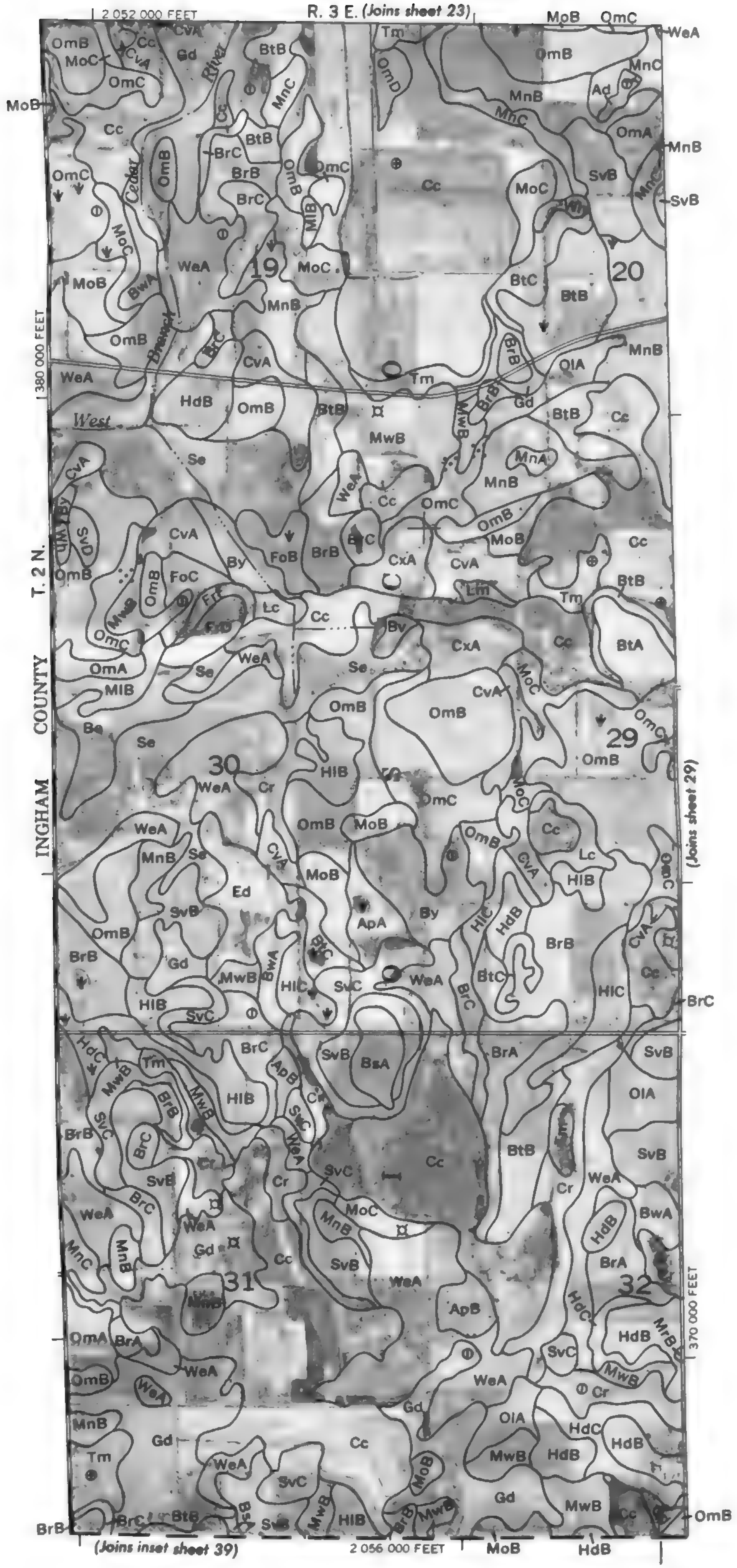
Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

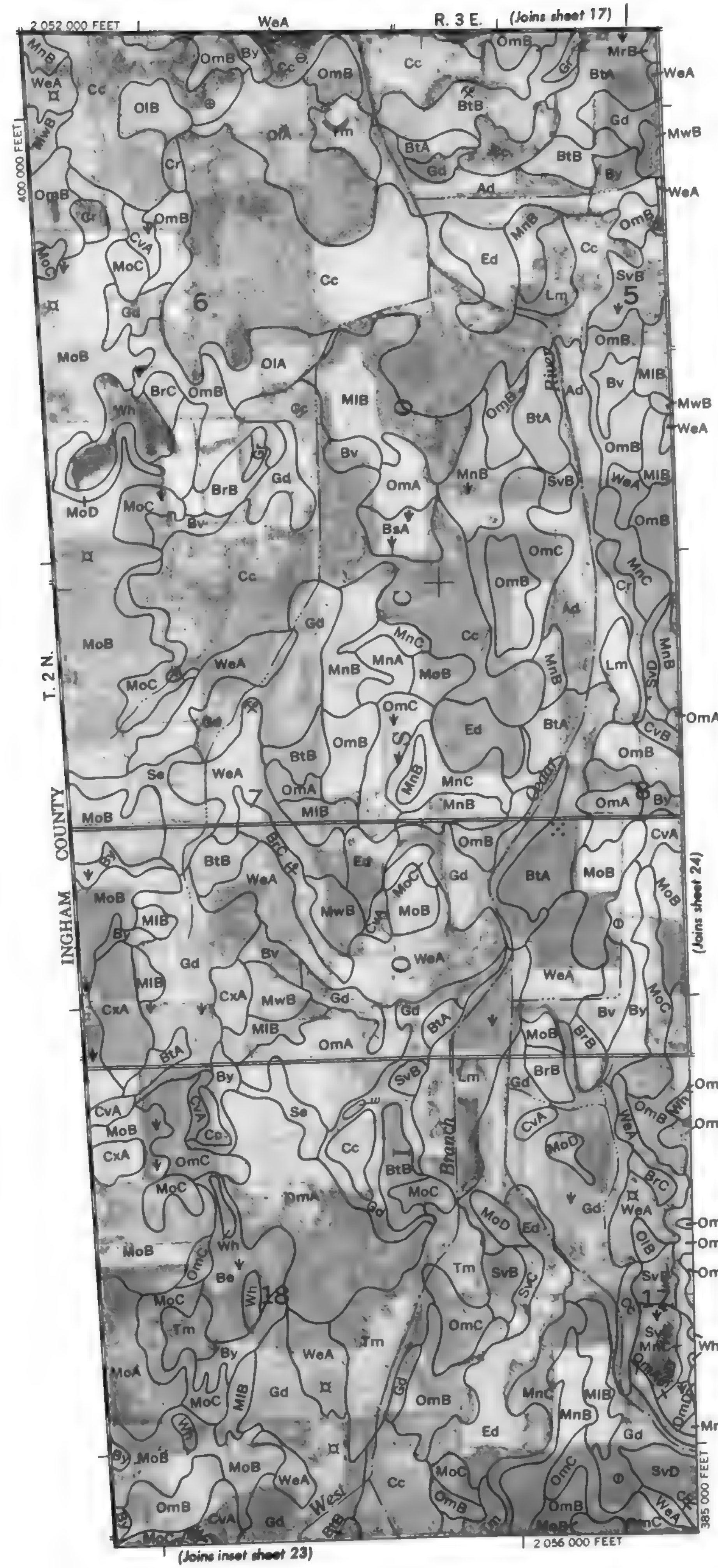
LIVINGSTON COUNTY, MICHIGAN NO. 23

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.



4000 AND 5000-FOOT GRID TICKS

4000 AND 5000-FOOT GRID TICKS



23

N

1 Mile

5000 Feet

Scale 1:20000

LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 24

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

LIVINGSTON COUNTY, MICHIGAN NO. 24

LIVINGSTON COUNTY, MICHIGAN NO. 25

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

Land division corners are approximately positioned on this map.

N

1 Mile

5000 Feet

Scale 1:20000

LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 26

Land division corners are approximately positioned on this map.

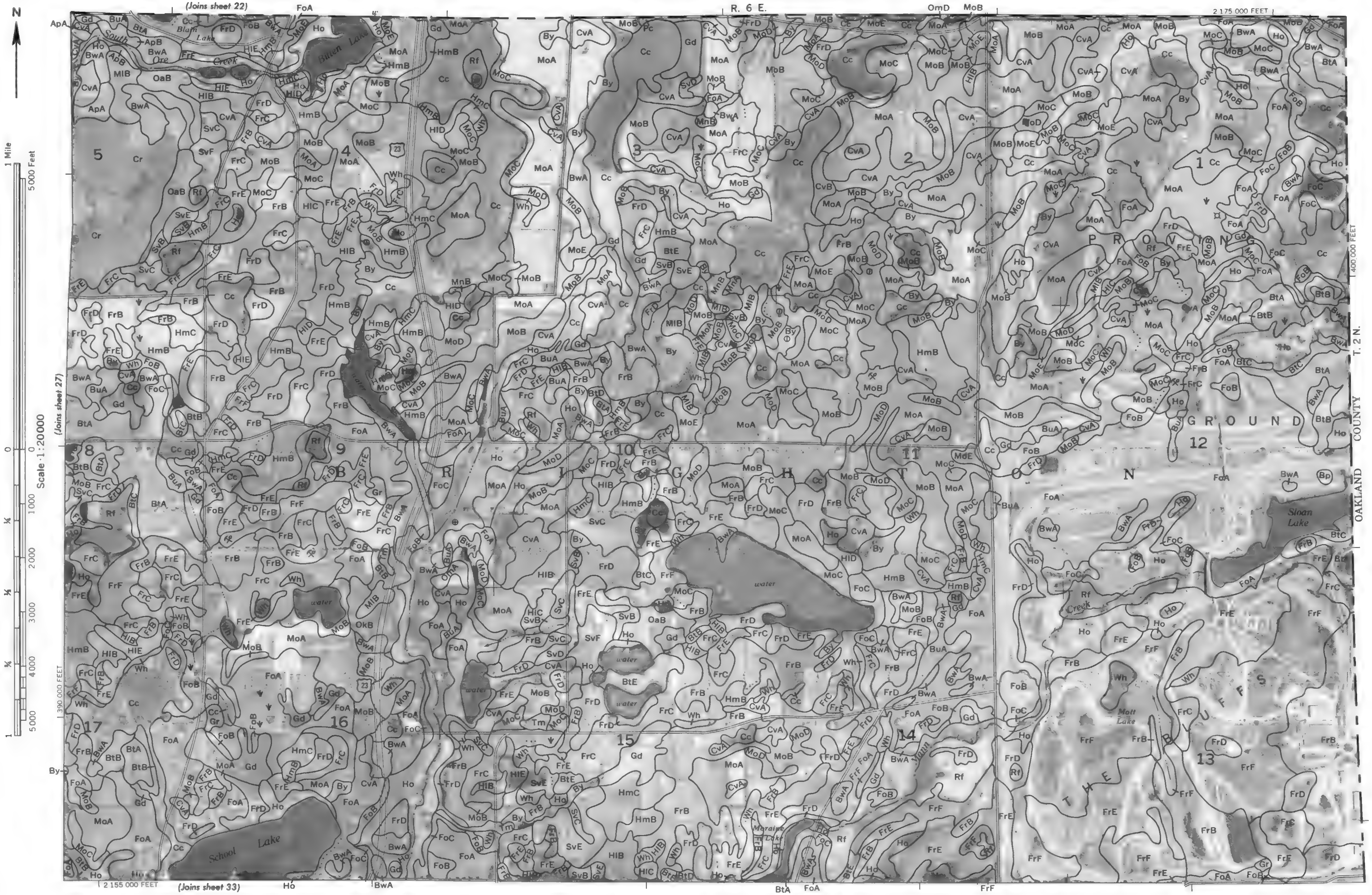
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

LIVINGSTON COUNTY, MICHIGAN NO. 26

LIVINGSTON COUNTY, MICHIGAN NO. 27

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

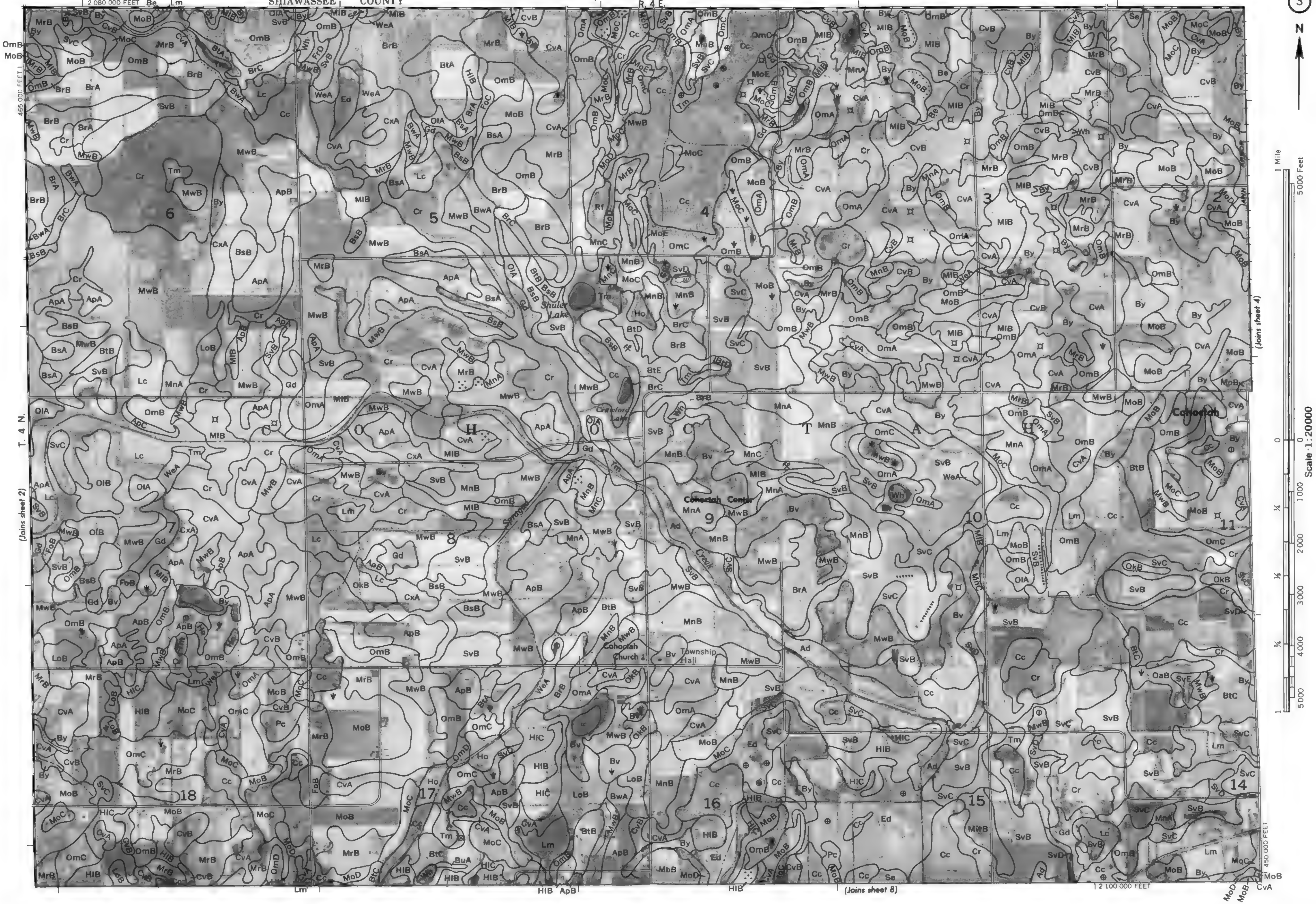
29

LIVINGSTON COUNTY, MICHIGAN NO. 29

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

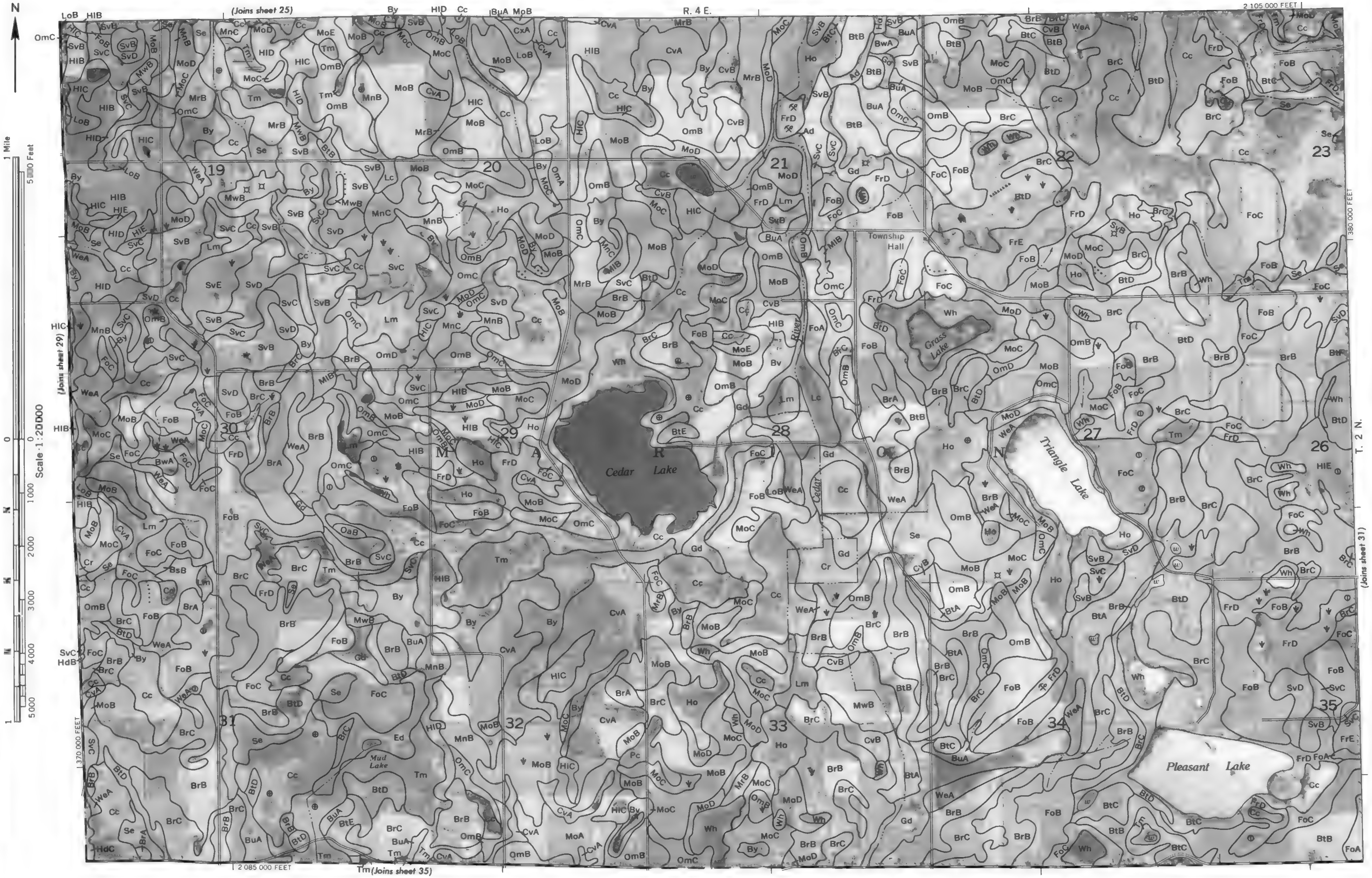
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

Land division corners are approximately positioned on this map.



LIVINGSTON COUNTY, MICHIGAN NO. 3

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station. Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone. Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

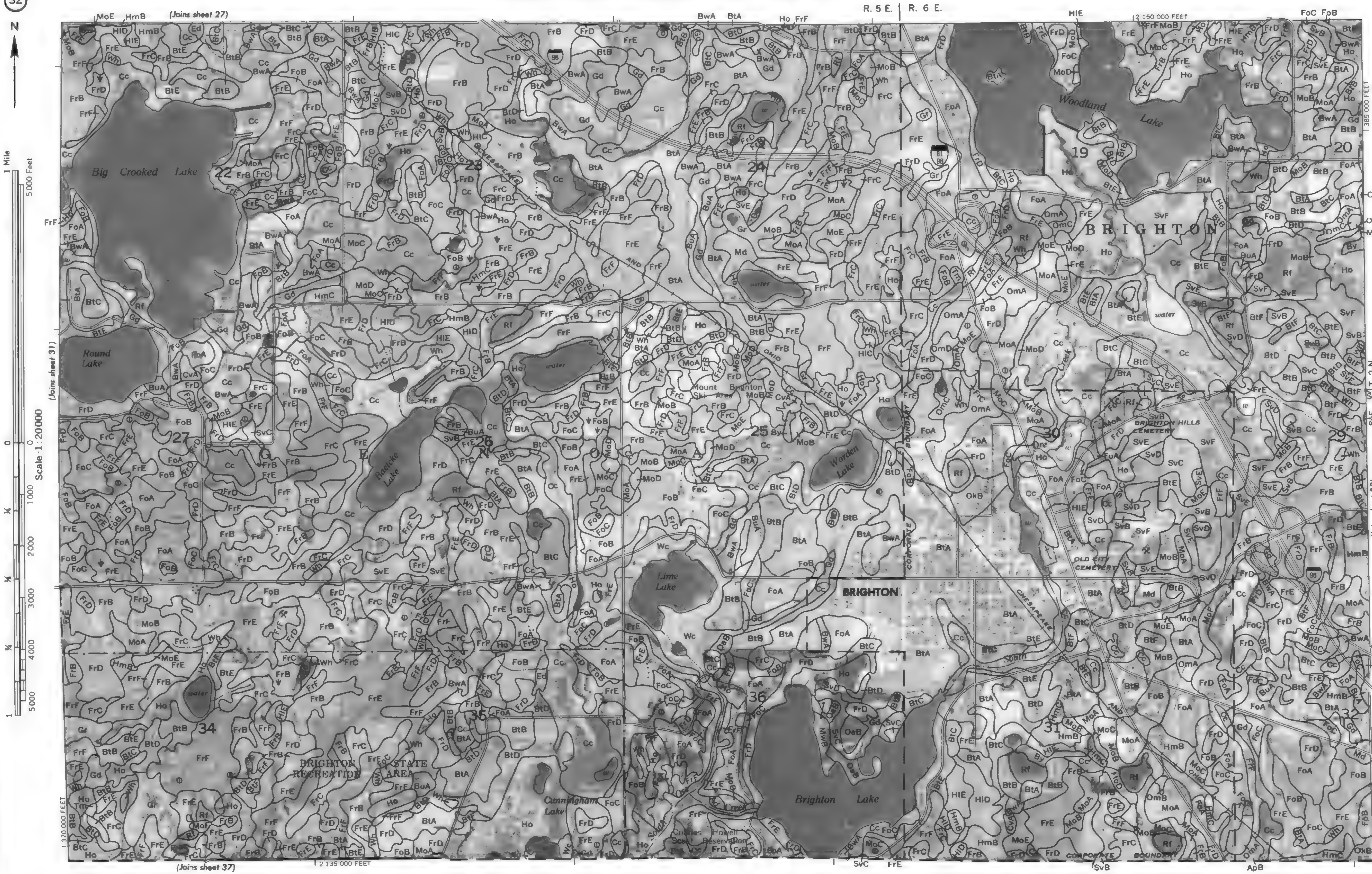
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

(31)

LIVINGSTON COUNTY, MICHIGAN NO. 31

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.

LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 32



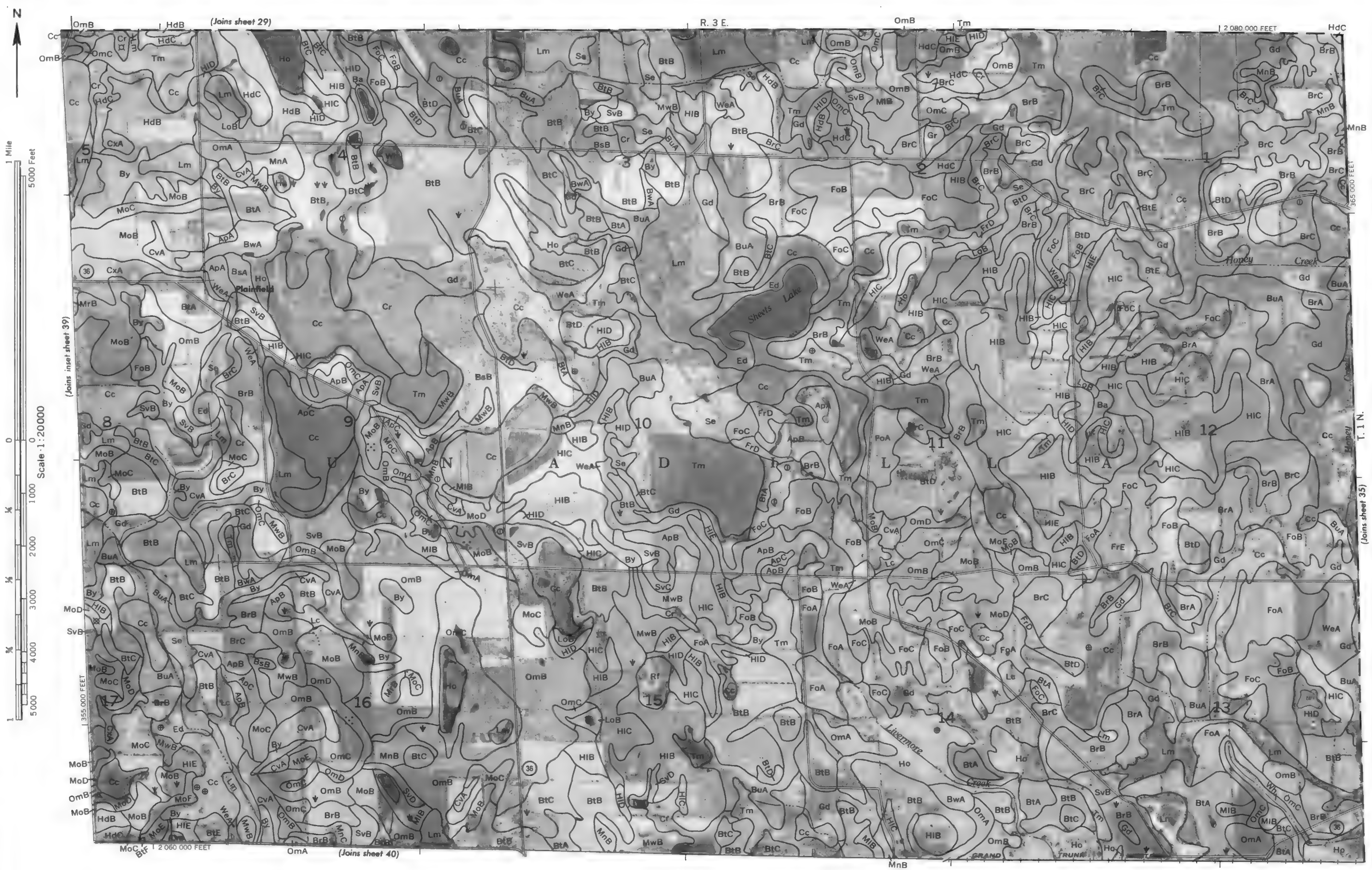
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

LIVINGSTON COUNTY, MICHIGAN NO. 32

LIVINGSTON COUNTY, MICHIGAN NO. 33

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.

LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 34

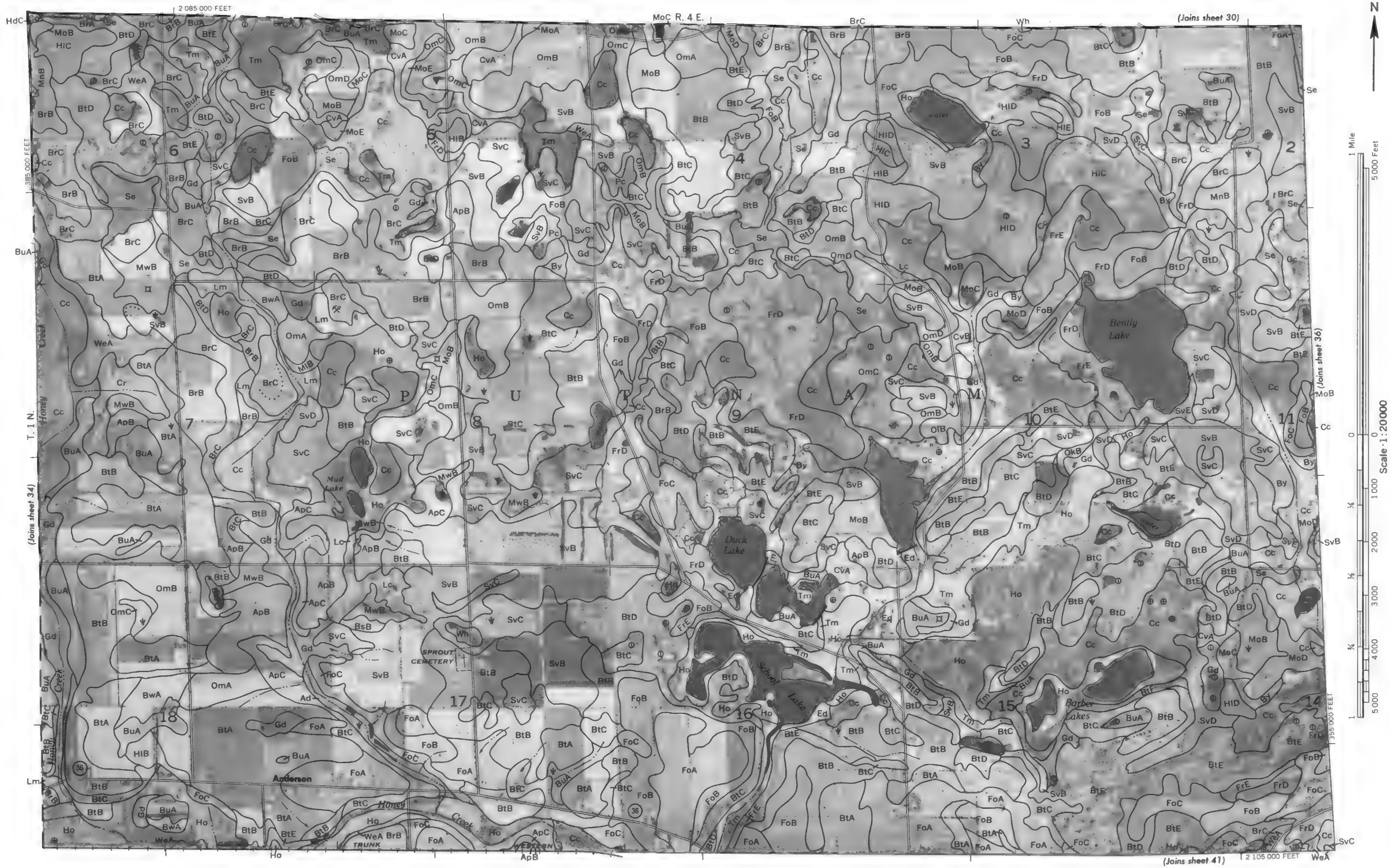


Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

LIVINGSTON COUNTY, MICHIGAN NO. 34



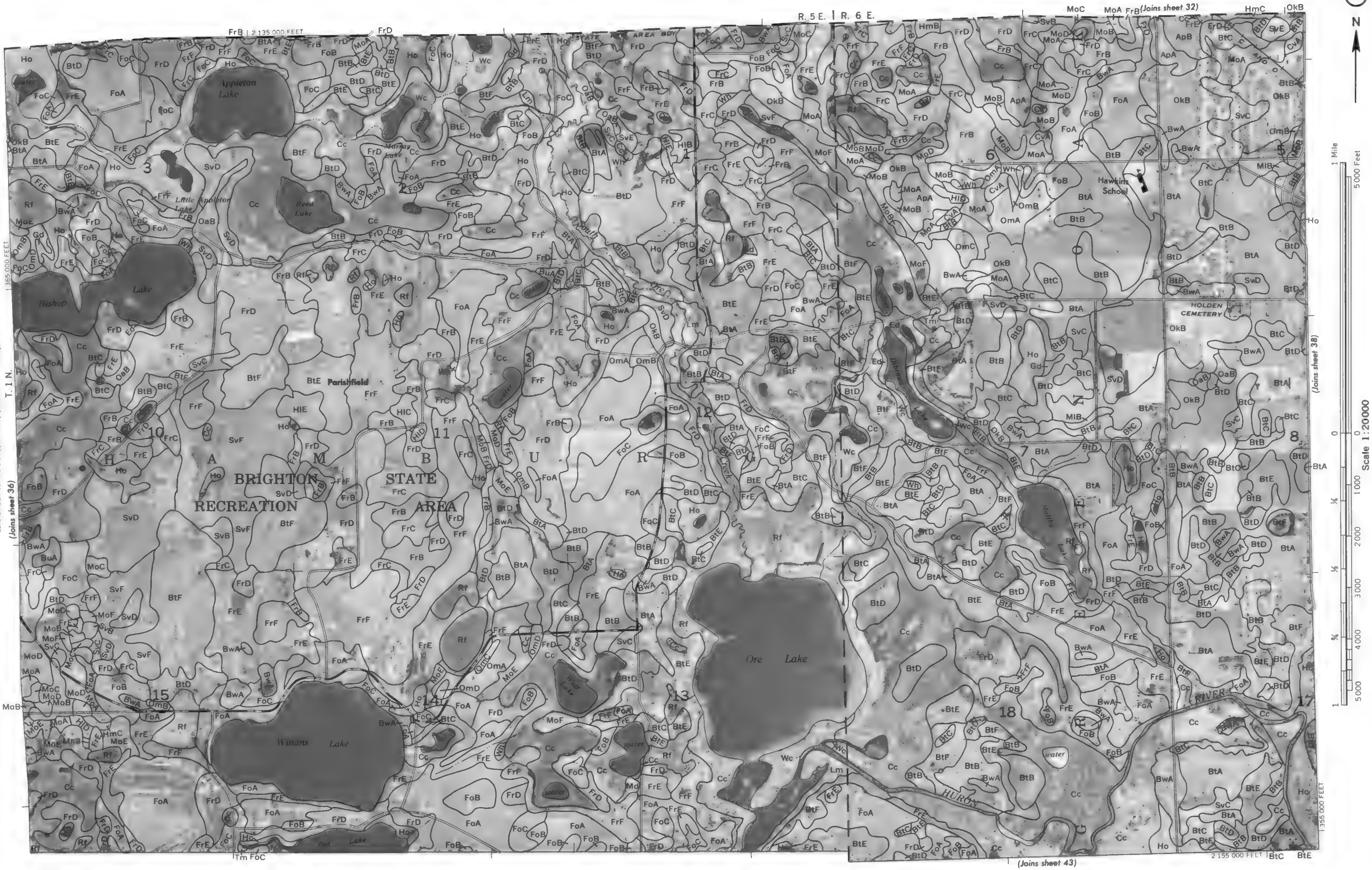
LIVINGSTON COUNTY, MICHIGAN NO. 35

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map

Land division corners are approximately positioned on this map

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.



LIVINGSTON COUNTY, MICHIGAN NO. 37

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station. Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone. Land division corners are approximately positioned on this map.

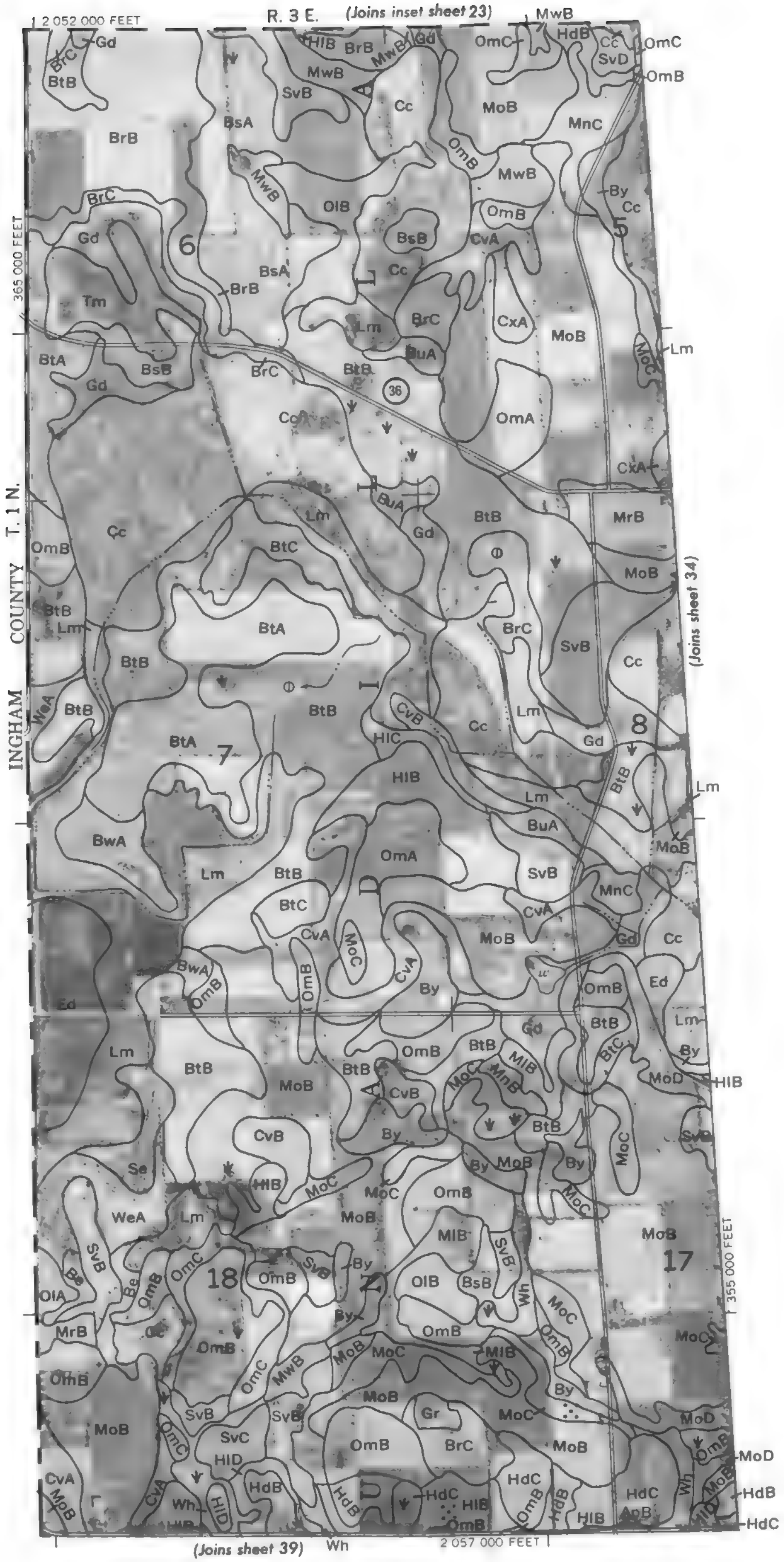
Land division corners are approximately positioned on this map.

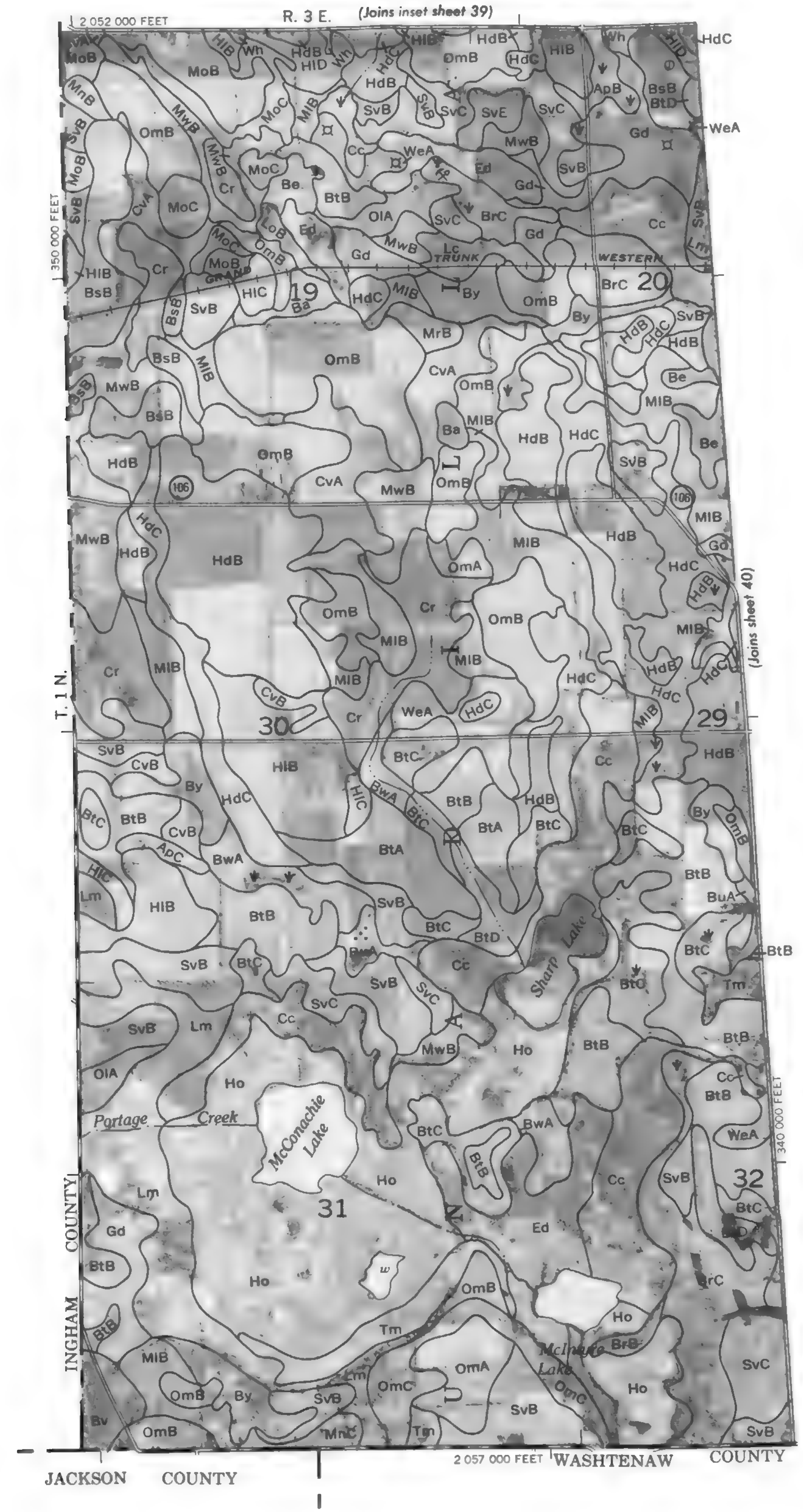
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

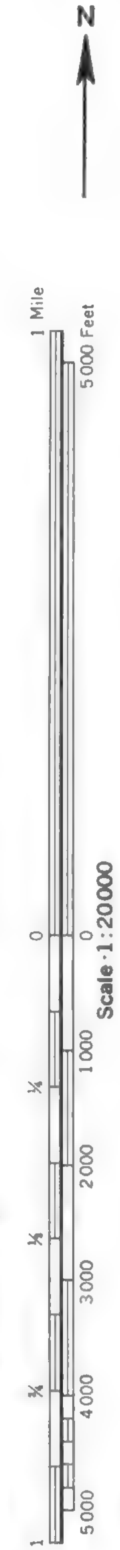
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

LIVINGSTON COUNTY, MICHIGAN NO. 39

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.







(4)

LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 4

N

Scale 1:20000

1 Mile

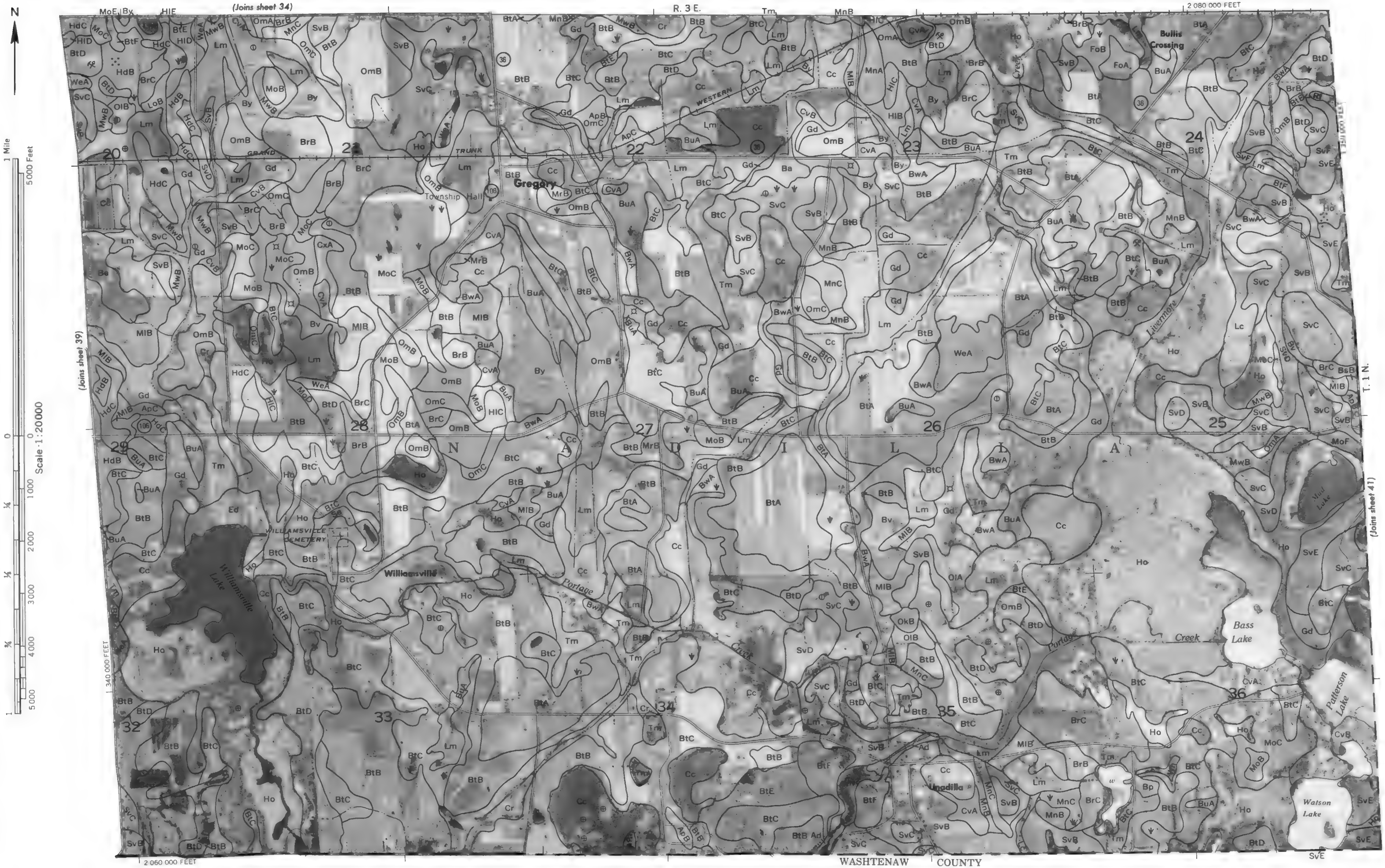
5000 Feet

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

Land division corners are approximately positioned on this map.

LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 40



Land division corners are approximately positioned on this map

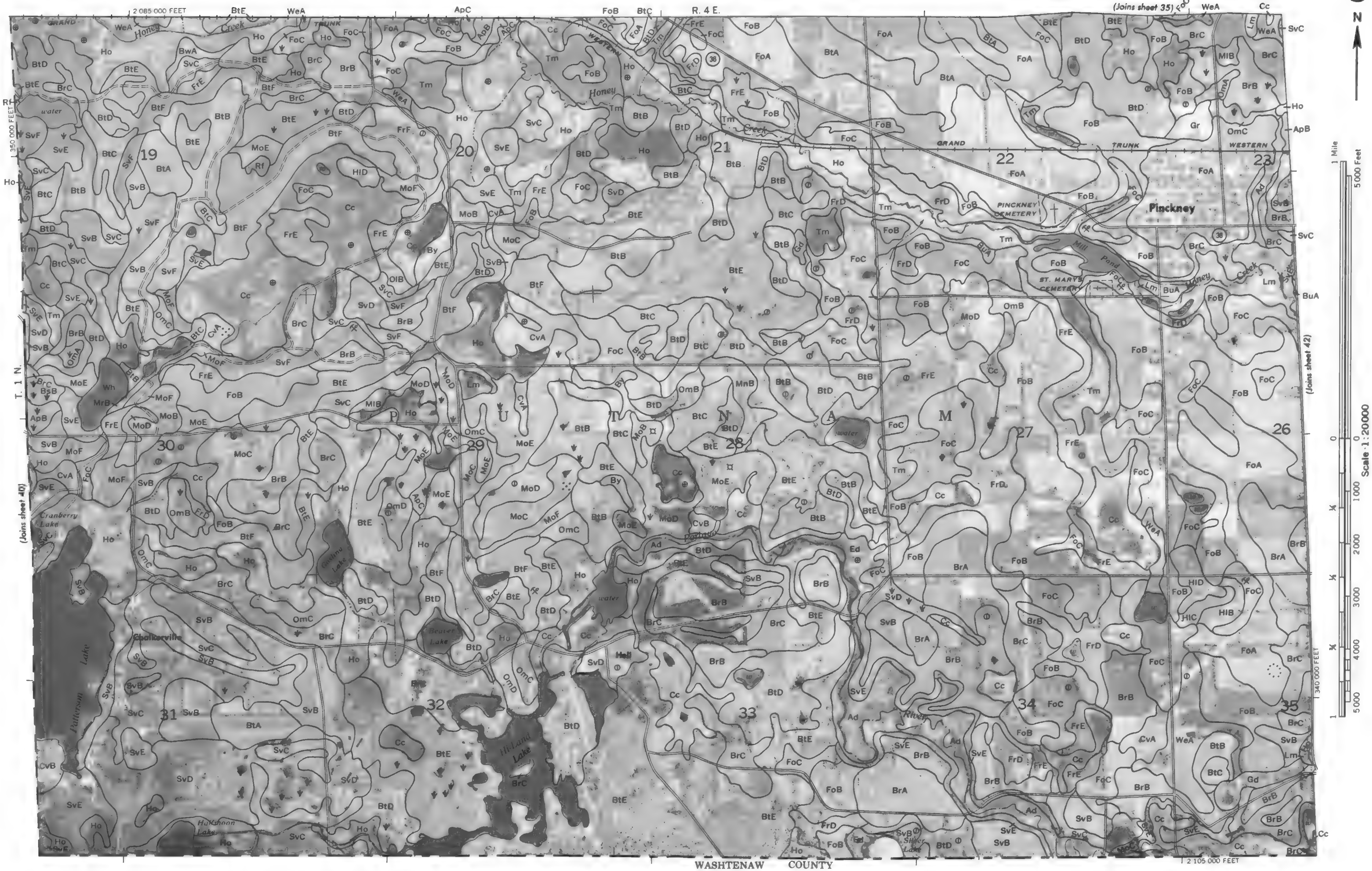
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station

41

LIVINGSTON COUNTY, MICHIGAN NO. 41

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.



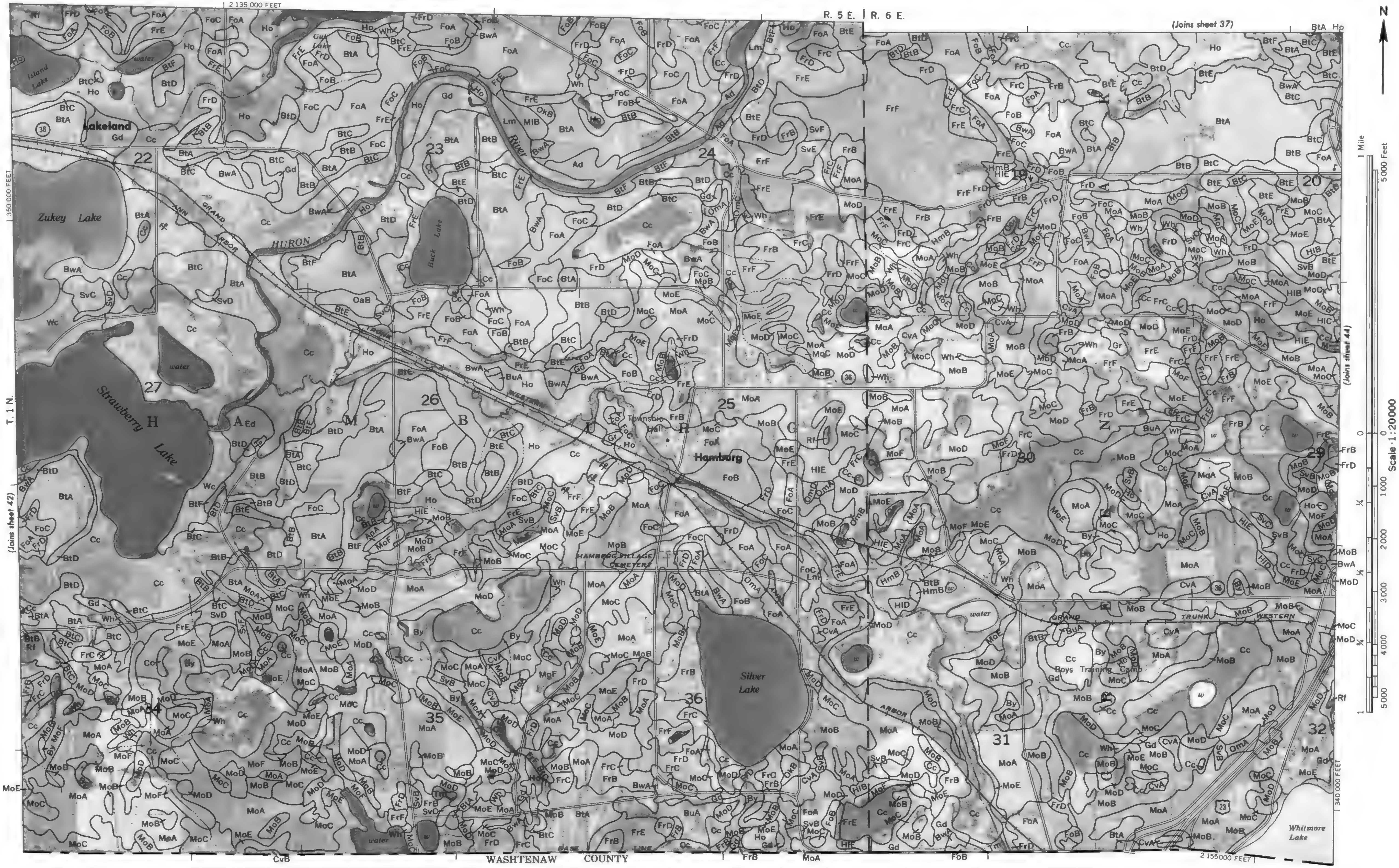
Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

LIVINGSTON COUNTY, MICHIGAN NO. 43

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 5

LIVINGSTON COUNTY, MICHIGAN NO. 5

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.

6

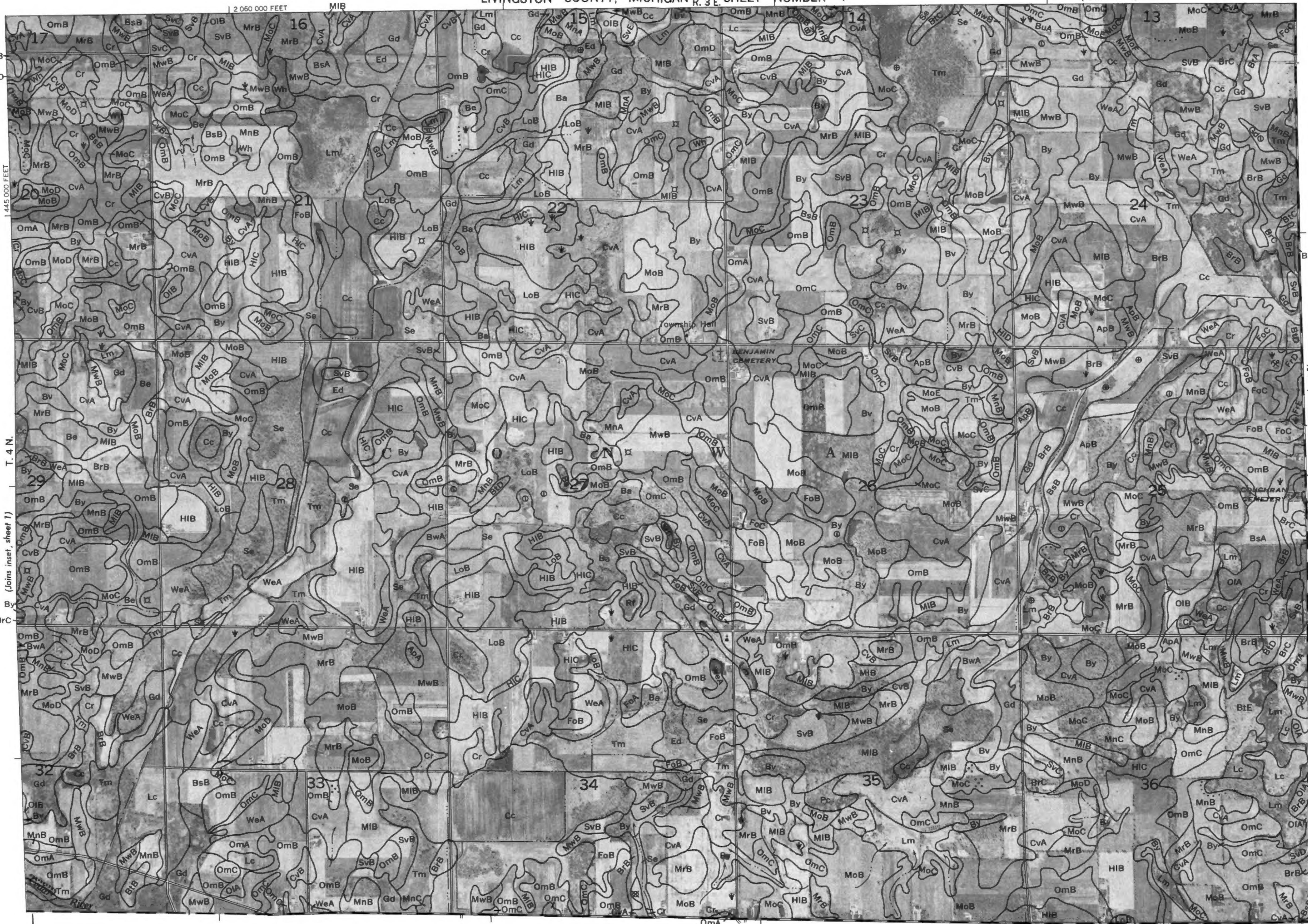
LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 6

Land division corners are approximately positioned on this map.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

LIVINGSTON COUNTY, MICHIGAN R. 3 E. SHEET NUMBER 7

(Joins sheet 2)

7



N

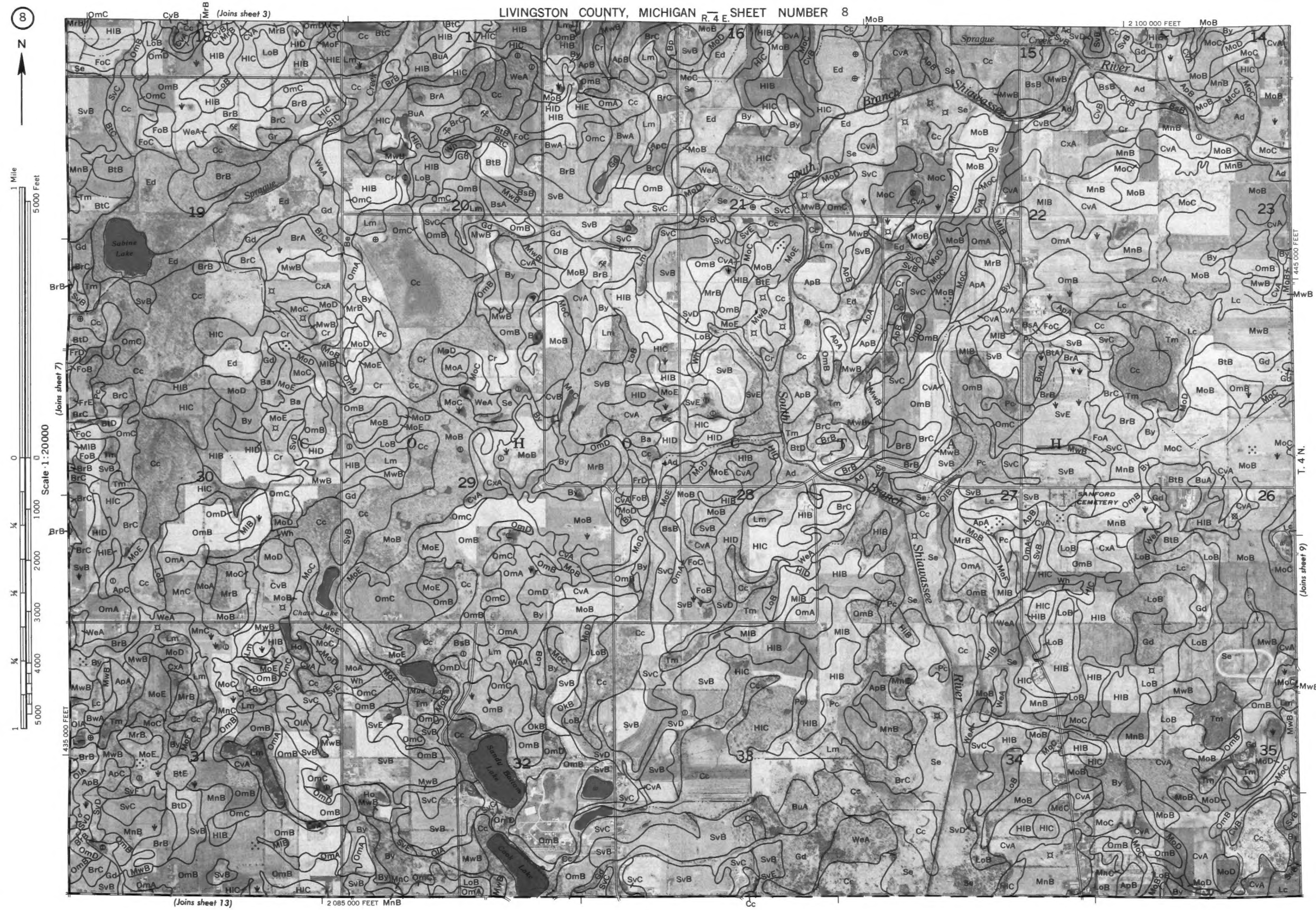
Scale 1:20000

1 Mile

5000 Feet

LIVINGSTON COUNTY, MICHIGAN NO. 7

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.

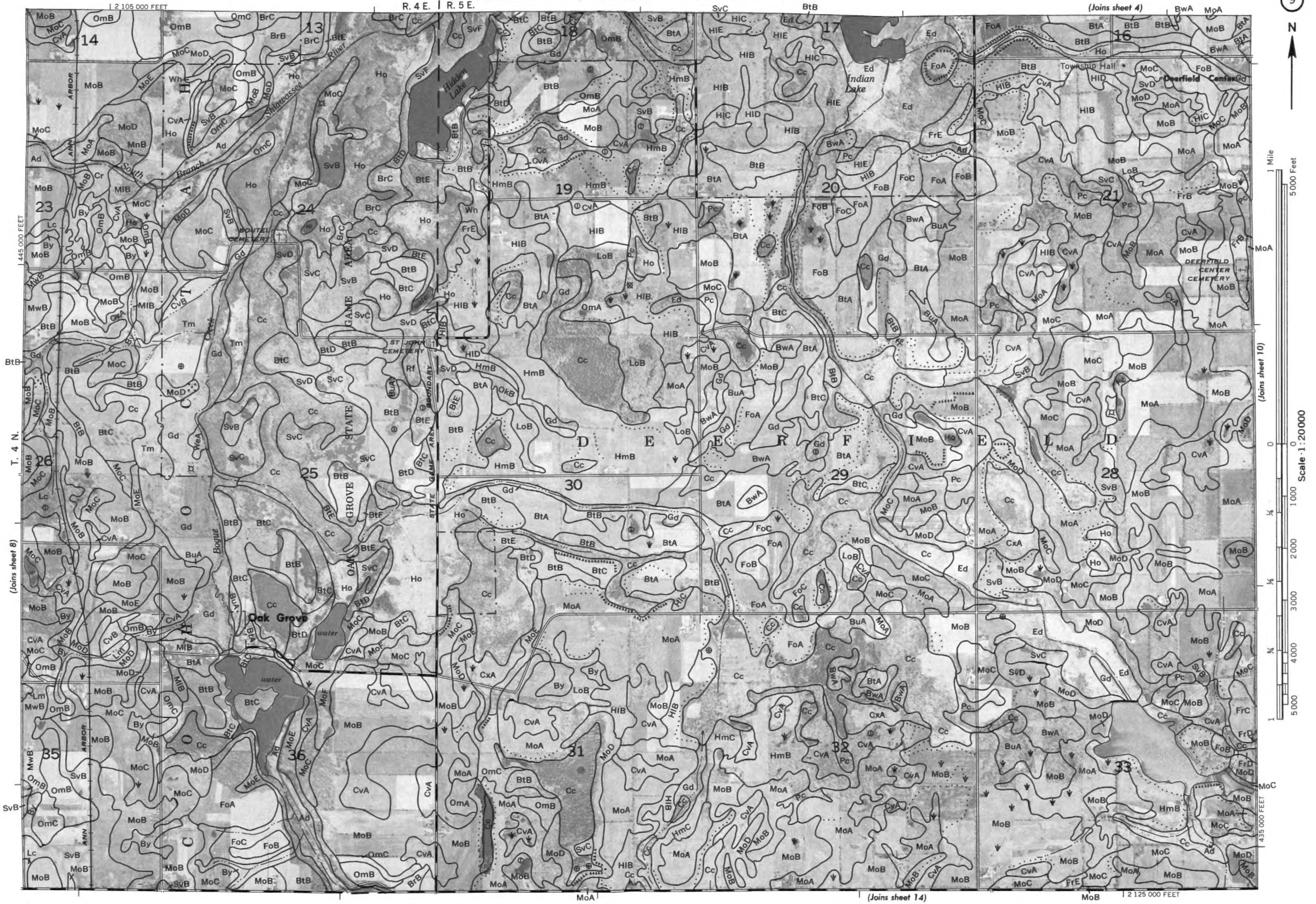


Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

LIVINGSTON COUNTY, MICHIGAN — SHEET NUMBER 9



LIVINGSTON COUNTY, MICHIGAN NO. 9

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, south zone.
Land division corners are approximately positioned on this map.